

SOIL SURVEY OF
Scotland County, Missouri



United States Department of Agriculture
Soil Conservation Service
In cooperation with
Missouri Agricultural Experiment Station

Major fieldwork for this soil survey was done in the period 1964-67. Soil names and descriptions were approved in 1969. Unless otherwise indicated, statements in the publication refer to conditions in the county at the time the survey was in progress. This survey was made cooperatively by the Soil Conservation Service and the Missouri Agricultural Experiment Station. It is part of the technical assistance furnished to the Scotland County Soil and Water Conservation District.

Copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Scotland County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the descriptions of the capability units.

Foresters and others can refer to the section "Woodland," where soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Engineers and builders can find, under "Engineering," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Scotland County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information given in the section "Additional Facts About the County."

Cover: Typical view of the Armster-Lamoni association.

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SOIL SURVEY OF SCOTLAND COUNTY, MISSOURI

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE MISSOURI AGRICULTURAL EXPERIMENT STATION

SCOTLAND COUNTY is in the northeastern part of Missouri. The total land area is 441 square miles, or 282,240 acres (fig. 1). In 1970 the county had a population of about 5,500. Most of the people earn a living through farming, and some commute to work in cities.

About 95 percent of the county is in farms. The general type of farming is growing grain and raising livestock. The major grain crops are corn, soybeans, wheat, and oats. Much of this is fed to cattle and hogs.

The county ranges from broad, nearly level upland flats to steep wooded slopes. Also, nearly level flood plains are along the major streams. The soils on the upland flats and adjacent gently sloping areas are of loess origin. Some soils formed in a thin mantle of loess and underlying glacial material. Texture of the soils on bottom land ranges from moderately coarse to fine. Erosion and wetness are limitations on uplands, and wetness is a limitation on bottom lands.

Memphis, the county seat and largest town in the county, has a population of about 2,000. Gorin, Rutledge, Granger, and Arbela are the other major towns.

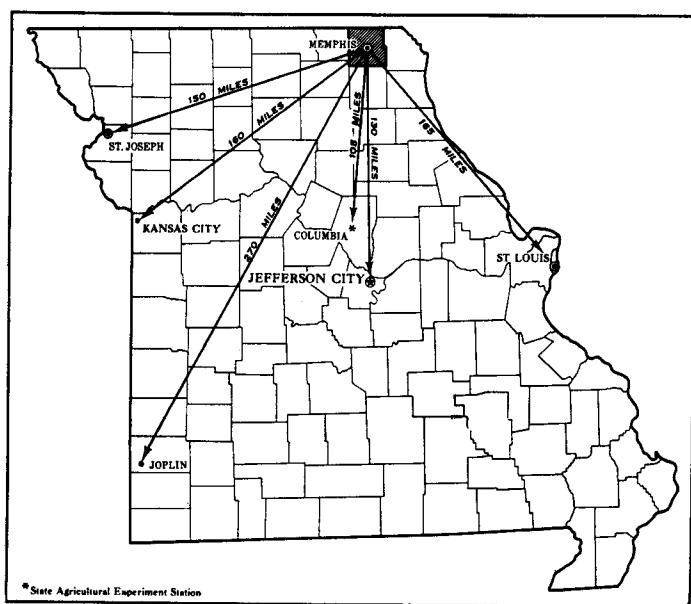


Figure 1.—Location of Scotland County in Missouri.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Scotland County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Edina and Kilwinning, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Armster loam, 5 to 9 percent slopes, eroded, is one of several phases within the Armster series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. A mapping unit of this kind shown on the soil map of Scotland County is the soil complex.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Blackoat-Arbela silt loams is an example.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Scotland County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a

road, building, or similar structure because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The four soil associations in Scotland County are described on the following pages.

1. Kilwinning-Edina association

Deep, somewhat poorly drained and poorly drained soils that have a medium-textured surface layer and a very slowly permeable subsoil

This association is on upland prairie, dominantly in the northern two-thirds of the county. It is mainly nearly level to gently sloping. Kilwinning and Edina soils formed in silty, windblown material.

This association makes up about 22 percent of the land area of the county. It is about 58 percent Kilwinning soils, 32 percent Edina soils, and 10 percent Lamoni and Armster soils.

Kilwinning soils are somewhat poorly drained. They are commonly gently sloping and downslope from and adjacent to Edina soils. In some places they are on convex ridgetops. They have a surface layer of very dark gray silt loam and a subsoil of dark-gray to grayish-brown mottled silty clay.

Edina soils are poorly drained, nearly level soils on broad flats. They have a surface layer of very dark gray silt loam, a subsurface layer of gray silt loam, and a subsoil of very dark gray mottled silty clay.

Lamoni and Armster soils are sloping and commonly are downslope from the Kilwinning soils. Lamoni soils are somewhat poorly drained, and Armster soils are moderately well drained.

This association is used mainly for crops. Most of the acreage is used for cash grain crops, and the rest for general farming. Corn, soybeans, and small grain are the main crops. Some rotations include meadow. The major limitations affecting use and management are erosion and wetness. Terraces and contour farming help to control erosion on the Kilwinning, Lamoni, and Armster soils. Surface drainage ditches remove excess water from the Edina soils.

2. Armster-Lamoni association

Deep, moderately well drained and somewhat poorly drained soils that have a medium-textured surface layer and a moderately slowly permeable or very slowly permeable subsoil

This association is on uplands, generally throughout the county. It consists of sloping to strongly sloping soils that formed in material deposited by glaciers. A thin loess cap covered the glacial material in which Lamoni soils formed.

This association makes up about 32 percent of the land area of the county. It is about 56 percent Armster soils, 25 percent Lamoni soils, and 19 percent Kilwinning and Gara soils.

Armster soils are moderately well drained. They are sloping and strongly sloping and generally are downslope from Kilwinning soils. In some places they are on convex ridges. Armster soils have a surface layer of very dark grayish-brown loam and a subsoil of reddish-brown to brown clay loam.

Lamoni soils are somewhat poorly drained. They also are sloping and strongly sloping and are downslope from the Kilwinning soils. They have a surface layer of very dark gray silt loam and a subsoil of dark grayish-brown to grayish-brown silty clay that contains enough sand to have a gritty feel.

Kilwinning soils are somewhat poorly drained, and Gara soils are moderately well drained.

The sloping soils of this association are used for crops, mainly corn, soybeans, and small grain. Most of the strongly sloping soils are in hay. Some are in pasture. The major hazard is erosion. Terraces and contour farming are needed to control erosion and keep soil loss to a minimum.

3. *Gara-Lindley association*

Deep, moderately well drained soils that have a medium-textured surface layer and a moderately slowly permeable subsoil

This association consists of strongly sloping to steep soils on uplands throughout the county. Both Gara and Lindley soils formed in glacial till, but the Gara soils formed under alternating prairie-timber vegetation. Gorin and Marion soils formed in loess.

This association makes up about 26 percent of the land area in the county. It is about 52 percent Gara soils, 38 percent Lindley soils, and 10 percent Gorin and Marion soils.

Gara soils are moderately well drained. They are strongly sloping and moderately steep and are downslope from Armster and Lamoni soils and upslope from the associated Lindley soils. They have a surface layer of very dark gray loam. The subsurface layer, where not mixed with the surface layer, is very dark grayish brown. The subsoil is dark yellowish-brown clay loam.

Lindley soils are moderately well drained. They are moderately steep to steep. They have a thin surface layer of very dark grayish-brown loam, a subsurface layer of dark grayish-brown loam, and a subsoil of yellowish-brown clay loam.

The sloping and somewhat poorly drained Gorin soils are upslope from Gara and Lindley soils. The nearly level and poorly drained Marion soils are upslope from Gorin soils.

Gara soils are used mainly for pasture. Lindley soils are mostly wooded, but some areas have been cleared for pasture. The major hazard affecting use of these soils is erosion. Trees and permanent pasture help to keep erosion to a minimum.

4. *Arbela-Blackoar-Westerville association*

Deep, poorly drained and somewhat poorly drained soils that have a medium-textured surface layer and a moderately permeable and moderately slowly permeable subsoil

This association consists of nearly level soils on flood plains, generally in the southern two-thirds of the county. It makes up about 20 percent of the land area of the county. It is about 30 percent Arbela soils, 19 percent Blackoar soils, 11 percent Westerville soils, and 40 percent Fatima, Chequest, Wabash, Vigar, Chariton, and Gifford soils.

Arbela soils are at slightly higher elevations on the flood plains at some distance from the streams. They

have a surface layer of very dark gray silt loam, a subsurface layer of dark-gray to dark grayish-brown silt loam, and a subsoil of dark-gray silty clay.

Blackoar and Westerville soils are on the flood plains adjacent to streams. Blackoar soils are very dark grayish-brown and very dark gray in the upper part and gray in the lower part. Westerville soils have a surface layer of dark grayish-brown silt loam, a subsurface layer of grayish-brown silt loam, and a subsoil of dark grayish-brown and grayish-brown silty clay loam.

The moderately well drained Fatima soils are in small areas close to the streams. The poorly drained Chequest soils and very poorly drained Wabash soils are in the lower areas or depressions of the flood plains. Vigar soils are in colluvial positions at the base of the upland slopes and are moderately well drained. Chariton soils are on high benches and are poorly drained. The somewhat poorly drained Gifford soils are on slopes of the high benches adjacent to the Chariton soils.

The soils of this association are used mostly for crops, mainly corn, soybeans, and small grain. The major limitation is wetness. Occasional flooding is also a hazard in many places.

Descriptions of the Soils

This section describes the soil series and mapping units in Scotland County. Each soil series is described in considerable detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. Unless it is otherwise stated, the colors given in the descriptions are those of a moist soil.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit in which the mapping unit has been placed. The page for the description of each capability unit can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (8).¹

A given soil series in this county may be identified

¹ Italic numbers in parentheses refer to Literature Cited, page 44.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent	Soil	Area	Extent
	<i>Acres</i>	<i>Percent</i>		<i>Acres</i>	<i>Percent</i>
Alvin fine sandy loam, 5 to 9 percent.....	395	0.1	Gorin silt loam, 5 to 9 percent slopes, eroded....	5,800	2.1
Arbela silt loam.....	16,900	6.0	Kilwinning silt loam, 2 to 5 percent slopes.....	38,250	13.6
Armster loam, 5 to 9 percent slopes, eroded.....	33,850	12.0	Lamoni silt loam, 5 to 9 percent slopes.....	25,900	9.2
Armster loam, 9 to 14 percent slopes, eroded.....	24,900	8.8	Lamoni silt loam, 9 to 14 percent slopes.....	560	.2
Blackoar silt loam.....	10,900	3.9	Lindley loam, 9 to 14 percent slopes, eroded.....	1,950	.7
Blackoar-Arbela silt loams.....	6,700	2.4	Lindley loam, 14 to 20 percent slopes, eroded.....	12,200	4.3
Chariton silt loam.....	2,350	.8	Lindley loam, 20 to 30 percent slopes, eroded.....	14,500	5.1
Chequest silty clay loam.....	5,100	1.8	Marion silt loam.....	225	(¹)
Colo silty clay loam.....	830	.3	Vigar loam, 2 to 5 percent slopes.....	2,850	1.0
Edina silt loam.....	22,000	7.8	Wabash silty clay.....	4,300	1.5
Fatima silt loam.....	4,800	1.7	Westerville silt loam.....	6,500	2.3
Gara loam, 9 to 14 percent slopes, eroded.....	20,000	7.1	Limestone quarry.....	60	(¹)
Gara loam, 14 to 20 percent slopes, eroded.....	18,000	6.4	Water.....	90	(¹)
Gifford silt loam, 2 to 5 percent slopes.....	1,600	.6			
Gifford silt loam, 5 to 9 percent slopes, eroded.....	730	.3	Total.....	282,240	100.0

¹ Less than 0.1 percent.

by a different name in a recently published soil survey of an adjacent county. Such differences in name result from changes in the concepts of soil classification that have occurred since publication. The characteristics of the soil series described in this county are considered to be within the range defined for that series. In those instances where a soil series has one or more features outside the defined range, the differences are explained.

Alvin Series

The Alvin series consists of deep, moderately rapidly permeable, well drained to moderately well drained soils of the uplands. These soils are on the sides and tops of ridges and the sides of high stream benches. They formed in material deposited by glacial water and in stream sediment. The native vegetation was hardwood trees.

In a representative profile the surface layer is dark grayish-brown and dark-brown fine sandy loam about 12 inches thick. Reaction in this layer is slightly acid. The subsoil is dark yellowish-brown sandy loam about 24 inches thick. The underlying material to a depth of 64 inches is yellowish-brown loamy sand. Reaction in the subsoil and underlying material is medium acid.

Alvin soils have a low to moderate available water capacity. Inherent fertility is low.

Representative profile of Alvin fine sandy loam, 5 to 9 percent slopes, in the southeast corner of the NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 19, T. 65 N., R. 11 W.

A11—0 to 6 inches, dark grayish-brown (10YR 4/2) and dark-brown (10YR 4/3) fine sandy loam, brown (10YR 5/3) dry; weak, fine, granular structure; hard; friable; very few fine roots; slightly acid; clear, smooth boundary.

A12—6 to 12 inches, dark-brown (10YR 3/3) fine sandy loam; weak, fine, granular structure; friable; very few fine roots; slightly acid; clear, smooth boundary.

B2—12 to 36 inches, dark yellowish-brown (10YR 4/4) sandy loam; single grain; friable; slightly sticky; medium acid; clear, smooth boundary.

C—36 to 64 inches, yellowish-brown (10YR 5/6) loamy sand; single grain; friable; medium acid.

The A1 horizon ranges from dark brown (10YR 3/3) through dark yellowish brown (10YR 4/4). The B2 and C horizons range from dark brown (10YR 4/3) through yellowish brown (10YR 5/6). The solum ranges from 35 to 50 inches in thickness.

The Alvin soils in Scotland County contain less clay and more coarse sand than is defined as the range for the series, but this difference does not alter their usefulness and behavior.

Alvin soils are associated with Lindley and Gara soils. They have less clay and more sand in the subsoil than Lindley soils and less distinct horizons than Gara soils.

Alvin fine sandy loam, 5 to 9 percent slopes (A1C).—

This soil is in irregularly shaped areas 5 to 50 acres in size. About half the acreage is on the sides and tops of ridges, and half is on the sides of high stream benches. The soils on stream benches are in uniformly shaped areas 5 to 15 acres in size. About 5 percent of the mapped area consists of Lindley soils in the uplands and Gifford soils on the benches.

The acreage on benches is mainly in pasture. The upland acreage is generally idle. This Alvin soil is suited to watermelons and cantaloups. The low available water capacity is the major limitation. If the soil is tilled and left without vegetative cover, soil blowing is a hazard. Capability unit IVe-7.

Arbela Series

The Arbela series consists of deep, moderately slowly permeable, somewhat poorly drained, nearly level soils. These soils occur throughout the county. They are at slightly higher elevations than the present flood plain, but are subject to occasional flooding. They formed in silty alluvium. The native vegetation was grass.

In a representative profile the surface layer is very dark gray silt loam about 11 inches thick. It is neutral in reaction. The subsurface layer is dark-gray and dark grayish-brown silt loam about 11 inches thick. Reaction is slightly acid in the upper 6 inches and strongly acid in the lower 5 inches. The subsoil is mainly dark-gray silty clay loam mottled with dark yellowish brown and yellowish brown. It is 46 inches thick.

Arbela soils have high to very high available water

capacity and high inherent fertility. They are used for row crops.

Representative profile of Arbela silt loam (0 to 2 percent slopes) in a field 100 feet east of the road in north-west corner of SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 5, T. 65 N., R. 10 W.

A1—0 to 11 inches, very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate, fine, granular structure; friable; many fine roots; neutral; abrupt, smooth boundary.

A21—11 to 17 inches, dark-gray (10YR 4/1) silt loam, gray (10YR 6/1) dry; moderate, thick, platy structure parting to moderate, fine, granular; friable; few fine roots; slightly acid; clear, smooth boundary.

A22—17 to 22 inches, dark grayish-brown (10YR 4/2) heavy silt loam; weak, medium, platy structure parting to moderate, fine, granular; friable; few fine roots; strongly acid; gradual, smooth boundary.

B2tg—22 to 54 inches, dark-gray (10YR 4/1) silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; firm; few fine roots; a few black (10YR 2/1) streaks in root channels; very few oxide concretions; strongly acid; gradual, smooth boundary.

B3g—54 to 68 inches, mottled dark-gray (10YR 4/1), dark grayish-brown (10YR 4/2), and gray (10YR 5/1) silty clay loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, fine, subangular blocky structure to structureless; firm; very few roots; few black (10YR 2/1) streaks in root channels; very few oxide concretions; slightly acid.

The A1 or Ap horizon ranges from very dark gray (10YR 3/1) through very dark grayish brown (10YR 3/2) and is 10 to 15 inches thick. The A2 horizon is dark gray (10YR 4/1) or dark grayish brown (10YR 4/2) and is 8 to 16 inches thick. The solum ranges from 48 inches to more than 5 feet in thickness.

Arbela soils are closely associated with Chequest, Wabash, and Westerville soils. They have a darker surface layer and a more prominent A2 horizon than Westerville soils. They are not so fine textured as Chequest and Wabash soils.

Arbela silt loam (Ar).—This is a nearly level soil in uniformly shaped areas, 10 to 50 acres in size, on low stream terraces. Small areas of Westerville and Colo soils are included in mapping. These inclusions make up less than 10 percent of the mapped areas.

This Arbela soil is well suited to all row crops grown in the county. Wetness is a moderate hazard. Capability unit IIw-1.

Armster Series

The Armster series consists of deep, moderately slowly permeable, moderately well drained soils of the uplands. These are sloping to strongly sloping soils on the sides and tops of ridges. They formed under a prairie-timber vegetation, in glacial till.

In a representative profile the surface layer is very dark grayish-brown and dark grayish-brown loam about 6 inches thick. Reaction is slightly acid in the upper 7 inches and medium acid in the lower 3 inches. The subsoil is dark-brown, reddish-brown, brown, and yellowish-brown clay loam about 37 inches thick. A glacial stone line generally occurs at the upper boundary of this layer (5). Reaction in the subsoil is strongly acid in the upper part to medium acid in the lower part. The underlying material is yellowish-brown loam. Reaction in this layer is very strongly acid.

Unless eroded, Armster soils have high available water capacity and high natural fertility. They erode easily if left unprotected.

Armster soils are used mainly for row crops and hay. A small acreage is in pasture.

Representative profile of Armster loam, 5 to 9 percent slopes, eroded, 700 feet southeast of square corner junction of Route M and road to Sand Hill. Southwest corner of NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 33, T. 64 N., R. 11 W.

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate, fine, granular structure; friable; few fine roots; slightly acid; clear, smooth boundary.

A12—7 to 10 inches, dark grayish-brown (10YR 4/2) and very dark grayish-brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; few, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, thick, platy structure; friable; few fine roots; medium acid; clear, smooth boundary.

B1t—10 to 16 inches, dark-brown (7.5YR 4/4) clay loam; few, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine, angular blocky and subangular blocky structure; firm; thin discontinuous clay films; medium acid; gradual, smooth boundary.

IIB21t—16 to 23 inches, reddish-brown (5YR 4/4) clay loam; common, fine, distinct, yellowish-red (5YR 5/6) mottles and common, fine, distinct, brown (10YR 5/3) mottles; moderate, fine, subangular blocky structure; firm; thin continuous clay films; weak stone line at top of horizon; strongly acid; gradual, smooth boundary.

IIB22t—23 to 33 inches, brown (10YR 5/3) heavy clay loam; common, fine, distinct, strong-brown (7.5YR 5/6) mottles and common, fine, distinct, reddish-brown (5YR 4/4) mottles; moderate, fine, subangular blocky structure; very firm; thin continuous clay films; strongly acid; gradual, smooth boundary.

11B31t—33 to 40 inches, yellowish-brown (10YR 5/6) clay loam; few, fine, faint, grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; firm; strongly acid; gradual, smooth boundary.

IIB32t—40 to 47 inches, yellowish-brown (10YR 5/8) light clay loam; few, fine, distinct, light brownish-gray (10YR 6/2) mottles; weak, medium, subangular blocky structure; firm; medium acid; gradual, smooth boundary.

C—47 to 70 inches, yellowish-brown (10YR 5/4) heavy loam; few black (10YR 2/1) organic stains; massive; friable; very strongly acid.

The Ap horizon in cultivated areas ranges from very dark gray (10YR 3/1) to very dark grayish brown (10YR 3/2). It ranges from loam to clay loam and is 6 to 10 inches thick. Thickness of the solum ranges from 40 to 65 inches.

Armster soils are downslope from Kilwinning soils and upslope from Gara soils. They have a stone line and reddish colors that are not typical of the Gara soils. The presence of glacial pebbles in the subsoil distinguishes them from Kilwinning soils.

Armster loam, 5 to 9 percent slopes, eroded (AsC2).—

This soil is in irregularly shaped areas, 5 to 35 acres in size, on the sides and tops of ridges. It has the profile described as representative of the series. Severely eroded areas make up about 1 percent of this mapping unit. These areas are designated on the detailed soil map by erosion symbols, each of which represents 2 acres.

This soil is well suited to crops commonly grown in the county. Erosion is a hazard. Capability unit IIIe-5.

Armster loam, 9 to 14 percent slopes, eroded (AsD2).—

This soil is in irregularly shaped tracts 5 to 25 acres in size. Severely eroded areas make up approximately 6 percent of the acreage. These areas are designated on the detailed soil map by erosion symbols, each of which represents 2 acres. Also included in mapping are small areas of Gara soils.

This Armster soil is best suited to hay. It can be cultivated occasionally for reseeded. Some areas are in

permanent pasture. Erosion is a hazard. Capability unit IVe-5.

Blackoar Series

The Blackoar series consists of deep, moderately permeable, poorly drained, nearly level soils that formed in alluvium. These soils are on flood plains throughout the county. They are subject to occasional flooding. The native vegetation was water-tolerant grasses.

In a representative profile the surface layer is very dark gray and very dark grayish-brown silt loam about 16 inches thick. The subsoil is dark-gray silt loam about 34 inches thick. The underlying material is mottled dark-gray and dark-brown silt loam. Reaction is neutral throughout the profile.

Blackoar soils have a very high available water capacity. Inherent fertility is moderate to high.

Most of the acreage is used for row crops. Some areas are still wooded. Blackoar soils are well suited to walnut trees.

Representative profile of Blackoar silt loam, 100 feet south of a road in the northwest corner of the NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 34, T. 67 N., R. 12 W.

A11—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak, very fine, granular structure; friable; many fine roots; many small worm holes; neutral; clear, smooth boundary.

A12—7 to 16 inches, very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; few, fine, faint, dark-brown (10YR 4/3) mottles; weak, very fine, granular structure; friable; few fine roots; many small worm holes; neutral; clear, smooth boundary.

B2g—16 to 50 inches, dark-gray (10YR 4/1) silt loam; few, fine, faint, dark-brown (10YR 3/3) mottles; weak, very fine, granular structure; friable; few fine roots; many small worm holes; neutral; gradual, smooth boundary.

Cg—50 to 70 inches, mottled dark-gray (10YR 4/1) and dark-brown (10YR 3/3) silt loam; structureless; friable; neutral.

The Ap horizon in cultivated areas is very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2). The A11 horizon ranges from 6 to 10 inches in thickness. The solum ranges from 36 to 60 inches in thickness.

Blackoar soils have a darker surface layer than Westerville soils. They are not so fine textured as Chequest, Colo, and Wabash soils. They are closely associated with Colo soils.

Blackoar silt loam (Bk).—This is a nearly level soil along old, meandering stream channels and narrow stream bottoms. It has the profile described as representative of the series. Areas are irregularly shaped and range from 10 to 50 acres in size.

Included with this soil in mapping are small areas of Chequest and Westerville soils. These inclusions make up less than 10 percent of the mapped areas.

This Blackoar soil is well suited to walnut trees. Small, inaccessible areas are wooded. Cleared areas are in row crops. Wetness is a moderate hazard. If feasible, installing surface drainage ditches can be considered. Capability unit IIw-1.

Blackoar-Arbela silt loams (Br).—This mapping unit is about 50 percent Blackoar soil and about 40 percent Arbela soil. These are nearly level soils in narrow valleys, generally concave in shape, along streams and tributaries. Areas are irregularly shaped and range from 20 to 80 acres in size. Blackoar and Arbela soils are so

intermixed that it is impossible to map them separately. The Arbela soil is described under the heading "Arbela Series."

Included with these soils in mapping are areas of Colo soils at the heads of drainageways and on alluvial fans washed from adjacent slopes. Included soils make up about 10 percent of a given mapped area.

Most of the acreage is wooded. Walnut tree plantings do very well. Cleared areas are in row crops or pasture. Occasional flooding is the major hazard. Capability unit IIw-1.

Chariton Series

The Chariton series consists of deep, slowly permeable, poorly drained soils that have a claypan in the subsoil. These are nearly level soils that are mainly on high benches along the major streams in the county. They formed in loess and the underlying alluvial sediment. The native vegetation was grass.

In a representative profile the surface layer is very dark grayish-brown silt loam that is neutral to strongly acid and is about 10 inches thick. The subsurface layer is grayish-brown silt loam that is strongly acid and about 8 inches thick. The subsoil is dark grayish brown and grayish brown, is mainly silty clay, and is about 32 inches thick. Reaction in this layer is medium acid in the upper part to neutral in the lower part. The underlying material is gray very fine sandy clay loam.

Chariton soils have high to moderate available water capacity. Inherent fertility is high.

Nearly all the acreage is used for row crops, small grain, and legumes.

Representative profile of Chariton silt loam in the northwest corner of the SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 19, T. 64 N., R. 10 W.

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, very fine, granular structure; friable; few fine roots; neutral; clear, smooth boundary.

A12—6 to 10 inches, very dark grayish-brown (10YR 3/2) silt loam; few, fine, faint, dark-brown (7.5YR 4/4) mottles; weak, thin, platy and moderate, very fine, granular structure; friable; few fine roots; strongly acid; abrupt, smooth boundary.

A2—10 to 18 inches, grayish-brown (10YR 5/2) silt loam, light gray (10YR 7/1) dry; weak, thin, platy and moderate, very fine, granular structure; friable; few fine roots; many fine worm holes; strongly acid;

B21t—18 to 24 inches, dark grayish-brown (10YR 4/2) to very dark grayish-brown (10YR 3/2) silty clay; few, fine, distinct, yellowish-brown (10YR 5/6) mottles and common, fine, distinct, strong-brown (7.5YR 5/8) mottles; moderate, fine, angular and subangular blocky structure; very firm; thin continuous clay films; medium acid; clear, smooth boundary.

B22t—24 to 35 inches, dark grayish-brown (10YR 4/2) silty clay; few, fine, distinct, yellowish-red (5YR 4/6) mottles and common, fine, distinct, strong-brown (7.5YR 5/8) mottles; moderate, fine, subangular blocky structure; very firm; thin continuous clay films; slightly acid; clear, smooth boundary.

B23t—35 to 40 inches, grayish-brown (2.5Y 5/2) silty clay; common, fine, distinct, strong-brown (7.5YR 5/8) mottles; weak, fine, subangular blocky structure; very firm; thin continuous clay films; neutral; clear, smooth boundary.

B3—40 to 50 inches, grayish-brown (2.5Y 5/2) silty clay loam; many, fine, distinct, strong-brown (7.5YR 5/8) mottles; weak, fine, subangular blocky structure to massive; firm; thin discontinuous clay films; very dark grayish-brown (10YR 3/2) clay films in old

root channels; few manganese concretions; some very fine sand; mildly alkaline; clear, smooth boundary.
IIC—50 to 71 inches, gray (10YR 5/1) very fine sandy clay loam; common, medium, distinct, dark-brown (7.5YR 4/4) mottles and few, medium, distinct, strong-brown (7.5YR 5/6) mottles; massive; friable; firm; few fine worm holes; sand fraction is very fine; mildly alkaline.

The Ap horizon ranges from very dark gray (10YR 3/1) to dark grayish brown (10YR 4/2). It is 6 to 10 inches thick and generally is silt loam. The A2 horizon ranges from grayish brown (10YR 5/2) to dark grayish brown (10YR 4/2). The solum ranges from 40 to 55 inches in thickness.

Chariton soils have a profile similar to that of Marion and Edina soils, but they have a darker colored surface layer than Marion soils and sandier lower horizons than Edina soils.

Chariton silt loam (Ch).—This is a nearly level soil on high stream benches. Tracts are 10 to 60 acres in size. Included with this soil in mapping is a small acreage of a soil that has a lighter colored and thinner surface layer.

This soil is well suited to all row crops grown in the county. Some areas are used for small grain and hay in rotation. Wetness is the major limitation. Capability unit IIw-2.

Chequest Series

The Chequest series consists of deep, moderately slowly permeable, poorly drained soils that are nearly level and subject to occasional flooding. They formed in alluvium along the major streams. The native vegetation was grass.

In a representative profile the surface layer is very dark gray silty clay loam about 14 inches thick. Reaction is medium acid to strongly acid. The subsoil, about 46 inches thick, is dark-gray and gray heavy silty clay loam. The upper 8 inches of the subsoil is strongly acid, and the rest is medium acid.

Chequest soils have a high to very high available water capacity and inherent fertility. They are used for row crops.

Representative profile of Chequest silty clay loam one-half mile north of Crawford on Route B, north of North Fabius River. It is in a field 600 feet east and 1,400 feet north of SW corner of sec. 32, T. 66 N., R. 12 W.

Ap—0 to 6 inches, very dark gray (10YR 3/1) light silty clay loam; moderate, fine, granular structure; firm; few fine roots; medium acid; clear, smooth boundary.

A12—6 to 14 inches, very dark gray (10YR 3/1) silty clay loam; weak, fine, subangular blocky structure; firm; few fine roots; strongly acid; clear, smooth boundary.

B21g—14 to 22 inches, dark-gray (10YR 4/1) heavy silty clay loam; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine, angular and subangular blocky structure; very firm; thin discontinuous clay films; strongly acid; clear, smooth boundary.

B22g—22 to 48 inches, dark-gray (10YR 4/1) and gray (10YR 5/1) heavy silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; very firm; thin discontinuous clay films; few very dark gray (10YR 3/1) organic stains; medium acid; clear, smooth boundary.

B3g—48 to 60 inches, gray (10YR 5/1) heavy silty clay loam; many, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; firm; medium acid.

The Ap horizon ranges from very dark gray (10YR 3/1) to black (10YR 2/1) and from silty clay loam to heavy silt loam.

It is 6 to 10 inches thick. The solum ranges from 35 to 60 inches in thickness.

Chequest soils are associated with Colo and Wabash soils. They are grayer than Colo soils and not so fine textured as Wabash soils.

Chequest silty clay loam (Cm).—This is a nearly level soil in uniformly shaped tracts 10 to 50 acres in size. Included with this soil in mapping are small areas of Colo and Wabash soils that make up less than 10 percent of the mapped area. These included soils require the same management as the Chequest soil.

This Chequest soil is well suited to all row crops grown in the county. Wetness is a moderate limitation. Surface drainage ditches should be considered. Capability unit IIw-1.

Colo Series

The Colo series consists of deep, moderately slowly permeable, poorly drained soils on alluvial fans and flood plains. These soils formed in silty alluvium. They are subject to occasional flooding.

In a representative profile the surface layer is black silty clay loam in the upper 6 inches and black and very dark gray silty clay loam in the lower 34 inches. Between depths of 40 and 78 inches the soil is mainly dark-gray silty clay loam.

Colo soils have a high to very high available water capacity. Natural fertility is medium, and organic-matter content is moderate. These soils are used mostly for row crops.

Representative profile of Colo silty clay loam (0 to 2 percent slopes) 35 feet east of Route U and 45 feet south of row of trees on west edge of SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 1, T. 64 N., R. 11 W.

Ap—0 to 6 inches, black (10YR 2/1) light silty clay loam; moderate, very fine, granular structure; friable; few fine roots; neutral; clear, smooth boundary.

A12—6 to 16 inches, black (N 2/0) silty clay loam; weak, fine, subangular blocky structure; firm; few fine roots; slightly acid; gradual, smooth boundary.

A13—16 to 30 inches, black (N 2/0) silty clay loam; few, fine, faint, dark-brown (10YR 3/3) mottles; weak and moderate, fine, subangular blocky structure; few fine roots; slightly acid; gradual, smooth boundary.

A14—30 to 40 inches, very dark gray (N 3/0) silty clay loam; common, fine, distinct, dark-brown (10YR 3/3) mottles; weak, fine, subangular blocky structure; firm; slightly acid; gradual, smooth boundary.

C1g—40 to 50 inches, dark-gray (N 4/0) silty clay loam; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine, subangular blocky structure; firm; neutral; gradual, smooth boundary.

C2g—50 to 60 inches, very dark gray (N 3/0) to dark-gray (N 4/0) heavy silty clay loam; common, fine, distinct, dark-brown (10YR 3/3) mottles; weak, fine, subangular blocky structure; firm; neutral; gradual, smooth boundary.

C3g—60 to 78 inches, dark-gray (N 4/0) heavy silty clay loam; few, fine, faint, yellowish-brown (10YR 5/6) mottles; structureless; very firm; neutral.

In cultivated areas the Ap horizon is black (10YR 2/1) or very dark gray (10YR 3/1) silty clay loam to heavy silt loam. It is 6 to 12 inches thick. The solum is 36 to 50 inches thick.

Colo soils are associated with Chequest and Wabash soils. Colo soils have a thicker and darker surface layer than Chequest soils. They are not so fine textured as Wabash soils.

Colo silty clay loam (Co).—This soil is in uniformly shaped areas, 10 to 50 acres in size, on flood plains. Slopes are 0 to 2 percent.

Areas of Chequest and Wabash soils included in mapping make up less than 10 percent of the mapped areas. They do not affect the use and management of this soil.

This Colo soil has slow surface runoff. Drainage ditches should be considered.

Colo soils are well suited to the row crops grown in the county. Capability unit IIw-1.

Edina Series

The Edina series consists of deep, nearly level, very slowly permeable, poorly drained soils on broad flats of the uplands. These soils formed in loess under grass vegetation.

In a representative profile the surface layer is very dark gray silt loam about 9 inches thick. Reaction is neutral. The subsurface layer is dark-gray silt loam about 9 inches thick. Reaction is medium acid. The subsoil is very dark gray in the upper 10 inches and grayish brown in the lower 42 inches. The upper 36 inches of the subsoil is very firm silty clay, and the lower 16 inches is silty clay loam. Reaction ranges from medium acid in the upper part to neutral in the lower part.

Edina soils have a high available water capacity and inherent fertility. They are used extensively for row crops.

Representative profile of Edina silt loam near the junction of Missouri Route 15 and County Route H, 1,200 feet west of the section line and 75 feet north of the center of Route 15 in the SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 6, T. 66 N., R. 11 W.

Ap—0 to 9 inches, very dark gray (10YR 3/1) silt loam; weak, very fine, granular structure; very friable; many roots; neutral; abrupt, smooth boundary.

A2—9 to 18 inches, dark-gray (10YR 4/1) silt loam, light gray (10YR 7/1) dry; moderate, medium, platy structure parting to weak, fine, subangular blocky; very friable; few, fine, faint, gray (10YR 5/1) mottles and very dark gray (10YR 3/1) stains; common, fine, hard, rounded, very dark brown oxides; many fine pores and roots; medium acid; abrupt, smooth boundary.

B21t—18 to 20 inches, very dark gray (10YR 3/1) light silty clay, very dark grayish brown (10YR 3/2) kneaded; strong, very fine, subangular blocky structure; very firm; many, fine, faint, dark-gray (10YR 4/1) and few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; many fine pores and roots; many dark-colored clay films; peds are coated with silica flour, light gray dry; medium acid; abrupt, smooth boundary.

B22t—20 to 28 inches, mottled very dark gray (10YR 3/1) and dark-gray (10YR 4/1) silty clay, very dark grayish brown (10YR 3/2) to dark grayish brown (10YR 4/2) kneaded; few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, prismatic structure parting to moderate, fine, angular blocky; very firm; thick continuous clay films; many oxides as described in the A2 horizon; few fine pores; common fine roots; medium acid; clear, smooth boundary.

B23t—28 to 40 inches, grayish-brown (2.5Y 5/2) silty clay, grayish brown (10YR 4/2) kneaded; weak, fine, angular and subangular blocky structure; very firm; common, fine, distinct, very dark gray (10YR 3/1) and yellowish-brown (10YR 5/4) mottles; many oxides as described in the A2 horizon; thick continuous clay films; few fine roots; neutral; gradual, smooth boundary.

B31t—40 to 54 inches, grayish-brown (2.5Y 5/2) light silty

clay; weak, medium, subangular blocky structure; firm; common, fine, distinct, yellowish-brown (10YR 5/6-5/4) mottles; thick discontinuous clay films; some black soft oxide material; neutral; gradual, smooth boundary.

B32t—54 to 70 inches, grayish-brown (2.5Y 5/2) silty clay loam; weak, medium, subangular blocky structure; nearly massive; friable; common, fine, distinct, yellowish-brown (10YR 5/6-5/4) mottles; common fine pores; common oxide material as described in the A2 horizon; thin discontinuous clay films; neutral.

The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) and ranges from 8 to 14 inches in thickness. The A2 horizon is dark gray (10YR 4/1) or gray (10YR 5/1). The solum is generally more than 60 inches thick. The loess is 7 to 10 feet thick in most places.

Edina soils have a prominent A2 horizon, which distinguishes them from the associated Kilwinning soils. They are more poorly drained than Kilwinning soils.

Edina silt loam (Ed).—This is a nearly level soil on upland flats. Areas are 15 to 80 acres in size. Included in mapping is a soil in the southeast part of the county that has a thinner, lighter colored surface layer. It requires the same management as the Edina soil.

This soil is well suited to all row crops grown in the county (fig. 2). Wetness is the major hazard. Surface drainage ditches should be considered. Capability unit IIw-2.

Fatima Series

The Fatima series consists of deep, moderately permeable, moderately well drained, nearly level soils on flood plains. These soils formed in recent silty sediments. They are subject to occasional flooding. The native vegetation was trees.

In a representative profile the surface layer is very dark grayish-brown silt loam about 12 inches thick. Reaction is neutral. The subsoil is dark grayish-brown heavy silt loam about 31 inches thick. Reaction is neutral in the upper part and slightly acid in the lower part. The underlying material is dark grayish brown silt loam to a depth of 64 inches. It contains enough sand to have a gritty feel. Reaction is slightly acid.

Fatima soils have a very high available water capacity and high inherent fertility. They are well suited to row crops and walnut trees.

Representative profile of Fatima silt loam 100 feet east of north-south fence and 50 feet north of center line of road, along the south edge of SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 35, T. 66 N., R. 12 W.

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak, very fine, granular structure; friable, few fine roots; many small worm holes; neutral; clear, smooth boundary.

A12—7 to 12 inches, very dark grayish-brown (10YR 3/2) heavy silt loam; weak, fine, granular structure; friable; few fine roots; many small worm holes; neutral; clear, smooth boundary.

B1—12 to 30 inches, dark grayish-brown (10YR 4/2) heavy silt loam; weak, medium, platy structure parting to weak, fine, granular; friable; many small worm holes; neutral; gradual, smooth boundary.

B2—30 to 43 inches, dark grayish-brown (10YR 4/2) heavy silt loam; few, fine, faint, dark-gray (10YR 4/1) and dark yellowish-brown (10YR 4/4) mottles; weak, fine, subangular blocky structure; friable; many



Figure 2.—Soybeans on nearly level Edina silt loam.

small worm holes; slightly acid; gradual, smooth boundary.

C—43 to 64 inches, dark grayish-brown (10YR 4/2) silt loam; few, fine, faint, dark-gray (10YR 4/1) and dark yellowish-brown (10YR 4/4) mottles; structureless; friable; slightly acid.

The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is silt loam, loam, or light silty clay loam. Thickness of the solum ranges from 40 to 60 inches. The C horizon commonly contains enough sand to have a gritty feel.

Fatima soils are closely associated with Blackoar and Westerville soils. Fatima soils have colors with chroma of 2 below the A horizon, whereas Blackoar soils have colors with chroma of 1 below the A horizon. Fatima soils have less distinct horizons than Westerville soils.

Fatima silt loam (Fa).—This soil is in irregularly shaped areas, 10 to 50 acres in size, along old meandering stream channels. Small areas of Westerville and Blackoar soils, which make up less than 10 percent of the area mapped, are included in mapping. In places small areas of this soil have a sandy overwash. These areas are designated on the detailed soil map by sand spot symbols.

Good stands of walnut trees are growing in inaccessible areas of this Fatima soil that have not been cleared. In areas that are large enough and cleared, row crops can be planted year after year. The major hazard is frequent flooding. Constructing levees to protect this soil against

flooding is economically feasible in large areas. Capability unit I-1.

Gara Series

The Gara series consists of deep, moderately slowly permeable, moderately well drained soils of the uplands. Gara soils are strongly sloping and moderately steep. These soils formed in glacial till under grass and tree vegetation.

In a representative profile the surface layer is very dark gray loam about 6 inches thick. Reaction is slightly acid. The subsurface layer is very dark grayish-brown loam about 4 inches thick. Reaction is strongly acid. The subsoil is dark-brown, dark yellowish-brown, and yellowish-brown clay loam. This layer is about 31 inches thick. Reaction is mainly strongly acid. The underlying material is mottled yellowish-brown and grayish-brown clay loam to a depth of 60 inches. Carbonates affect neutral and alkaline reactions.

Gara soils have moderate to high available water capacity and high inherent fertility. Most areas of Gara soils are in pasture.

Representative profile of Gara loam, 9 to 14 percent slopes, eroded, approximately 255 feet south of the south end of small bridge, then 45 feet east of center line of

road in wooded area in SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 28, T. 66 N., R. 11 W.

- A1—0 to 6 inches, very dark gray (10YR 3/1) loam; weak, fine, granular structure; very friable; common fine roots; slightly acid; clear, smooth boundary.
- A2—6 to 10 inches, very dark grayish-brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak, thin, platy structure parting to weak, fine, granular; friable; few fine roots; strongly acid; clear, smooth boundary.
- B1—10 to 13 inches, dark-brown (10YR 4/3) and dark yellowish-brown (10YR 4/4) light clay loam; moderate, fine, subangular blocky structure; firm; very few fine roots; strongly acid; clear, smooth boundary.
- B2t—13 to 30 inches, dark yellowish-brown (10YR 4/4) heavy clay loam; moderate, fine, subangular blocky structure; firm; thin discontinuous clay films; strongly acid; clear, smooth boundary.
- B3t—30 to 41 inches, yellowish-brown (10YR 5/4 and 10YR 5/6) clay loam; few, medium, distinct, grayish-brown (10YR 5/2) mottles; weak to moderate, fine, subangular blocky structure; firm; thick clay films in old root channels; mildly alkaline; clear, smooth boundary.
- C—41 to 60 inches, mottled yellowish-brown (10YR 5/4-5/6) and grayish-brown (10YR 5/2) medium clay loam; weak, medium, subangular blocky structure to massive; firm; mildly alkaline.

The A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) and ranges in thickness from 6 to 10 inches. The A2 horizon ranges from very dark grayish brown (10YR 3/2) to grayish brown (10YR 5/2). Thickness of the solum ranges from 36 to 70 inches.

In the Gara soils of Scotland County, the upper 20 inches of the subsoil contains more clay than is defined as the range for the Gara series. This difference does not alter the usefulness and behavior of the soil.

Gara soils have darker colored and thicker A1 or Ap horizons than the associated Lindley soils. Their subsoil is not so red as the subsoil of the associated Armster soils.

Gara loam, 9 to 14 percent slopes, eroded (GcD2).—This is a strongly sloping soil in irregularly shaped tracts, 10 to 50 acres in size, on the sides and at the heads of drainageways. It has the profile described as representative of the series, but the surface layer ranges to very dark grayish brown. In some places the subsoil is mixed with the surface layer. This soil is approximately 1 percent uneroded and 7 percent severely eroded. The severely eroded areas are designated on the detailed soil map by an erosion symbol that represents 2 acres. Areas of Armster soils included in mapping with this soil make up less than 10 percent of the area mapped.

This Gara soil is well suited to hay and pasture. Deep-rooted legumes do well. Occasional cultivation for re-seeding should be on the contour. Erosion is the major hazard. Capability unit IVE-1.

Gara loam, 14 to 20 percent slopes, eroded (GcE2).—This is a moderately steep soil in irregularly shaped areas, 10 to 40 acres in size, on the sides of drainageways. The surface layer is very dark grayish brown. About 4 percent of this unit is uneroded, and 8 percent is severely eroded. The severely eroded areas are designated on the detailed soil map by an erosion symbol that represents 2 acres.

Small areas of Lindley soils, which make up less than 10 percent of the mapped area, are included in mapping. Also included are small areas of steep Gara soils, which make up less than 2 percent of the mapped area.

This soil is well suited to permanent pasture. A top-dressing of fertilizer, applications of lime, and controlled

grazing help to maintain a good growth of pasture. Erosion is the major hazard. Capability unit VIe-1.

Gifford Series

The Gifford series consists of deep, very slowly permeable, somewhat poorly drained soils. These soils are mainly on the sides of high stream benches along the major streams in the county. Gifford soil formed in loess and underlying alluvial sediments. The native vegetation was grass.

In a representative profile the surface layer is very dark grayish-brown, slightly acid silt loam in the upper 7 inches and dark grayish-brown, strongly acid heavy silt loam in the lower 4 inches. The subsoil is silty clay to silty clay loam about 39 inches thick. The color ranges from dark grayish brown to light brownish gray. Reaction in the upper 13 inches is strongly acid. The lower part is medium and slightly acid. The underlying material is gray very fine sandy clay loam. Reaction is neutral.

Gifford soils have high available water capacity and medium inherent fertility. They are used for all crops grown in the county.

Representative profile of Gifford silt loam, 2 to 5 percent slopes, 600 feet north of north terminus of Route Y, 50 feet east of the road in a field along the west edge of SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 13, T. 64 N., R. 11 W.

- Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, very fine, granular structure; friable; many fine roots; slightly acid; clear, smooth boundary.
- A3—7 to 11 inches, dark grayish-brown (10YR 4/2) heavy silt loam; moderate, fine, granular structure; friable; few fine roots; strongly acid; clear, smooth boundary.
- B1—11 to 17 inches, dark grayish-brown (10YR 4/2) silty clay loam; few, fine, faint, yellowish-brown (10YR 5/4) mottles; weak to moderate, fine, subangular blocky structure; firm; few fine roots; many fine worm holes; strongly acid; clear, smooth boundary.
- B21t—17 to 24 inches, dark grayish-brown (10YR 4/2) silty clay; common, fine, distinct, yellowish-brown (10YR 5/6) and few, fine, distinct, yellowish-red (5YR 4/6) mottles; moderate, fine, angular and subangular blocky structure; very firm; many fine worm holes; thin continuous clay films; strongly acid; clear, smooth boundary.
- B22t—24 to 32 inches, grayish-brown (10YR 5/2) silty clay; common, fine, distinct, yellowish-brown (10YR 5/6) and few, fine, distinct, strong-brown (7.5YR 5/8) mottles; moderate, fine, angular and subangular blocky structure; very firm; many fine worm holes; thin continuous clay films; few manganese concretions; medium acid; clear, smooth boundary.
- B31t—32 to 42 inches, mottled grayish-brown (10YR 5/2), yellowish-brown (10YR 5/6), and strong-brown (7.5YR 5/6) silty clay loam; weak, fine, subangular blocky structure; firm; many fine worm holes; thin discontinuous clay films; many manganese concretions; medium acid; clear, smooth boundary.
- B32—42 to 50 inches, light brownish-gray (2.5Y 6/2) silty clay loam; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; many fine worm holes; thick clay films in old root channels; few medium sand grains; neutral; clear, smooth boundary.
- IIC—50 to 63 inches, gray (10YR 5/1) very fine sandy clay loam; few, medium, distinct, reddish-brown (5YR 4/4) mottles; massive; firm; neutral.

The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It ranges from 6 to 9 inches in thickness and from silt loam to light silty clay loam in

texture. The B2 horizon ranges in color from dark gray (10 YR 4/1) through grayish brown (10YR 5/2). Thickness of the solum ranges from 30 to 50 inches.

The Gifford soils are similar to Kilwinning soils, but the content of sand is more than 10 percent.

Gifford silt loam, 2 to 5 percent slopes (GfB).—This is a gently sloping soil in areas, 5 to 30 acres in size, on the sides of high stream benches. It has the profile described as representative of the series. Included in mapping are some soils that have a lighter colored surface layer and some small areas of Gifford soils that have stronger slopes.

This Gifford soil is used mainly for row crops and small grain. Erosion is the major hazard. Contour farming and terracing on long slopes help control erosion. Capability unit IIe-5.

Gifford silt loam, 5 to 9 percent slopes, eroded (GfC2).—This is a sloping soil in uniformly shaped areas, 3 to 20 acres in size, on the sides of high stream benches. The cultivated surface layer is very dark grayish brown and dark grayish brown. In some places the subsoil is mixed with the remaining surface layer. The profile of this soil is similar to that described as representative of the series, but the surface layer is 2 or 3 inches thinner. Included with this soil in mapping are small areas of Gifford silt loam, 2 to 5 percent slopes.

This soil is used mainly for row crops and small grains. Some areas are in hay and permanent pasture. Erosion is the major hazard. In most places the length of slopes is only 50 to 100 feet. Terraces, therefore, are not practical. Farming across the slope helps control erosion. Capability unit IIIe-5.

Gorin Series

The Gorin series consists of deep, slowly permeable, somewhat poorly drained, sloping soils of the upland. These soils are on the sides and tops of ridges. They formed in 30 to 50 inches of loess and underlying glacial materials. The native vegetation was trees.

In a representative profile the surface layer is very dark gray silt loam that is neutral in reaction and about 3 inches thick. The subsurface layer is dark grayish-brown, strongly acid heavy silt loam about 6 inches thick. The subsoil is silty clay loam to a depth of about 41 inches. It is dark brown in the upper 12 inches and dark grayish brown and grayish brown in the next 20 inches. Reaction is strongly acid. The lower part of the subsoil is brown and yellowish-brown clay loam and light clay. Reaction in this part is medium acid.

Gorin soils have a moderate to high available water capacity. Inherent fertility is low.

These soils are used for pasture, hay, trees, and some row crops.

Representative profile of Gorin silt loam, 5 to 9 percent slopes, eroded, 8.75 miles east of Memphis, off U.S. Highway 136. It is 78 feet northwest of the western-most fireplace in Smith Park, in the center of SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 9, T. 65 N., R. 10 W.

A1—0 to 3 inches, very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry, very dark grayish brown (10YR 3/2) kneaded; moderate, very fine, granular structure; friable; common fine roots; neutral; abrupt, smooth boundary.

A2—3 to 9 inches, dark grayish-brown (10YR 4/2) heavy

silt loam, pale brown (10YR 6/3) dry, dark grayish brown (10YR 4/2) kneaded; light-gray (10YR 7/1) silt coatings; weak, medium, platy structure parting to moderate, fine, granular; friable; common fine roots; strongly acid; clear, smooth boundary.

B1—9 to 15 inches, dark-brown (10YR 4/3) silty clay loam, dark brown (10YR 4/3) kneaded; few, fine, faint, yellowish-brown (10YR 5/4) mottles; moderate, fine, subangular blocky and angular blocky structure; firm; few fine roots; strongly acid; gradual, smooth boundary.

B21t—15 to 21 inches, dark-brown (10YR 4/3) and brown (10YR 5/3) silty clay, yellowish brown (10YR 5/4) kneaded; common, fine, distinct, strong-brown (7.5 YR 5/6) mottles; moderate, fine, subangular blocky structure; very firm; very few fine roots; thin continuous clay films; strongly acid; gradual, smooth boundary.

B22t—21 to 26 inches, dark grayish-brown (10YR 4/2) heavy silty clay, yellowish brown (10YR 5/4) kneaded; many, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine, subangular blocky structure; sticky and plastic; very few fine roots; thin continuous clay films; strongly acid; gradual, smooth boundary.

B23t—26 to 32 inches, grayish-brown (2.5YR 5/2) silty clay, yellowish brown (10YR 5/4) kneaded; few, fine, distinct, reddish-brown (5YR 4/4) and strong-brown (7.5YR 5/6) mottles; weak to moderate, fine, subangular blocky structure; very firm; very fine roots; thin continuous clay films; strongly acid; gradual, smooth boundary.

B31t—32 to 41 inches, grayish-brown (2.5Y 5/2) silty clay loam, yellowish brown (10YR 5/4) kneaded; common, fine, distinct, strong-brown (7.5 YR 5/6) mottles; weak, medium, subangular blocky structure; firm; very few fine roots; thin, continuous, dark yellowish-brown (10YR 4/4) clay films in old root channels; medium acid; clear, smooth boundary.

IIB32t—41 to 53 inches, mottled brown (10YR 5/3) and yellowish-brown (10YR 5/6) clay loam, yellowish brown (10YR 5/4) kneaded; weak, medium, subangular blocky structure; firm; very few fine roots; thin, continuous, dark yellowish-brown (10YR 4/4) clay films in old root channels; medium acid.

IIB2tb—53 to 61 inches, brown (7.5YR 4/4) light clay; common, fine, prominent, yellowish-brown (10YR 5/6), red (2.5YR 4/6), and yellowish-red (5YR 5/6) mottles; strong, fine, subangular blocky structure; firm; thick clay films on faces of peds; common fine gravel; pebble band at top of horizon; medium acid.

The A1 horizon ranges from very dark gray (10YR 3/1) through dark grayish brown (10YR 4/2), and the A2 horizon, if present, from dark grayish brown (10YR 4/2) through brown (10YR 5/3). The A horizon is 5 to 12 inches thick.

The gradual change from the surface layer to the subsoil distinguishes Gorin soils from the associated Marion soils. Gorin soils have a finer textured B2t horizon than the associated Lindley soils, which formed entirely in glacial till.

Gorin silt loam, 5 to 9 percent slopes, eroded (GoC2).—

This soil is in irregularly shaped areas, 3 to 25 acres in size, on the sides and tops of ridges. In places the surface layer is mixed with the subsurface layer.

Areas of Marion and Lindley soils included in mapping make up about 10 percent of the total acreage. Included areas of a gently sloping Gorin silt loam on ridge-tops make up about 7 percent.

Most of the acreage is wooded or is used for hay and pasture. Capability unit IIIe-5.

Kilwinning Series

The Kilwinning series consists of deep, very slowly permeable, somewhat poorly drained soils of the uplands. These soils are gently sloping and are on the sides and

tops of convex ridges. They formed in loess under grass vegetation.

In a representative profile the surface layer is very dark gray heavy silt loam about 8 inches thick. Reaction is medium acid. The subsoil is dark-gray, gray, and dark grayish-brown silty clay in the upper 22 inches and grayish-brown and gray silty clay loam in the lower 28 inches. Reaction is strongly acid in the upper part of the subsoil and medium, slightly acid, and neutral in the lower part. The underlying material is yellowish-brown heavy silt loam. Reaction is neutral.

Kilwinning soils have moderate to high available water capacity. Their natural fertility level is high. They are used extensively for row crops.

Representative profile of Kilwinning silt loam, 2 to 5 percent slopes, one-fourth mile west of center of four corner intersection at Kilwinning, then 75 feet southwest of east gate post, in northeast corner of the NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 15, T. 66 N., R. 13 W.

- Ap—0 to 8 inches, very dark gray (10YR 3/1) heavy silt loam, gray (10YR 5/1) dry, very dark grayish brown (10YR 3/1) kneaded; moderate, very fine, granular structure; friable; few fine roots; medium acid; abrupt, smooth boundary.
- B1tg—8 to 14 inches, dark-gray (10YR 4/1) light silty clay, dark grayish brown (10YR 4/2) kneaded; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine, subangular and angular blocky structure; firm; few fine roots; thin continuous clay films; thin, continuous, light-gray (10YR 6/1) dry silt coatings on surface of peds; strongly acid; gradual, smooth boundary.
- B21tg—14 to 18 inches, dark-gray (10YR 4/1) silty clay, grayish brown (10YR 5/2) kneaded; many, fine, distinct, strong-brown (7.5YR 5/8) mottles; few very dark gray (10YR 3/1) organic stains; moderate, fine, subangular blocky structure; firm; few fine roots; thin continuous clay films; strongly acid; gradual, smooth boundary.
- B22tg—18 to 24 inches, dark grayish-brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) kneaded; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; firm; thin continuous clay films; strongly acid; gradual, smooth boundary.
- B23tg—24 to 30 inches, gray to grayish-brown (10YR 5/1–5/2) light silty clay, grayish brown (2.5Y 5/2) kneaded; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine to medium, subangular blocky structure; firm; thin continuous clay films; medium acid; gradual, smooth boundary.
- B31tg—30 to 42 inches, grayish-brown (2.5Y 5/2) silty clay loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine to medium, subangular blocky structure; firm; thin continuous clay films; slightly acid; gradual, smooth boundary.
- B32tg—42 to 58 inches, gray (10YR 5/1) light silty clay loam; common, medium, distinct, dark-brown (7.5YR 4/4) and few, medium, distinct, yellowish-red (5YR 4/6) mottles; weak, medium, subangular blocky structure; firm; thin discontinuous clay films; neutral; gradual, smooth boundary.
- C—58 to 65 inches, yellowish-brown (10YR 5/6) heavy silt loam; few, medium, distinct, gray (10YR 5/1) mottles; structureless; friable; neutral.

The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It ranges from 6 to 10 inches in thickness and from silt loam to silty clay loam in texture. The B2 horizon ranges from dark gray (10YR 4/1) to grayish brown (2.5Y and 10YR 5/2). Thickness of the solum may range from 40 inches to more than 60 inches. The loess is generally 6 to 8 feet thick.

Kilwinning soils do not have either the glacial till in the B horizon that is typical of the adjacent Lamoni soils or the

prominent A2 horizon that is typical of the associated Edina soil. Armster soils formed entirely in glacial till.

Kilwinning silt loam, 2 to 5 percent slopes (KIB).—This is a gently sloping soil in irregularly shaped areas, 10 to 80 acres in size, on the sides and tops of ridges. The cultivated surface layer is very dark gray. About 6 percent of this unit is eroded. Included with this soil in mapping are small areas of Lamoni and Armster soils, which make up less than 10 percent of mapped area.

This Kilwinning soil is well suited to all crops grown in the county. Row crops are grown extensively. Erosion is the major hazard. Terraces and waterways should be installed if these soils are farmed intensively. Capability unit IIe-5.

Lamoni Series

The Lamoni series consists of deep, very slowly permeable, somewhat poorly drained soils of the uplands. These soils are sloping and strongly sloping and are on the sides and at the heads of drainageways and on the sides and tops of ridges. They formed in loess and underlying glacial till under grass vegetation.

In a representative profile the surface layer is heavy silt loam about 13 inches thick. The upper part is very dark gray, and the lower part very dark grayish brown. Reaction is neutral in the upper part and strongly acid in the lower part. The subsoil is dark grayish-brown and grayish-brown silty clay loam to clay in the upper 21 inches. The 24 inches below this is yellowish-brown clay loam. Reaction is medium to strongly acid in the upper part and neutral in the lower part.

Lamoni soils are used for all crops grown in the county. Their available water capacity is moderate to high, and their natural fertility level is high.

Representative profile of Lamoni silt loam, 5 to 9 percent slopes, 265 feet north of Route W on north edge of SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 25, T. 64 N., R. 11 W.

- Ap—0 to 9 inches, very dark gray (10YR 3/1) heavy silt loam, dark gray (10YR 4/1) dry; moderate, very fine, granular structure; friable; many fine roots; neutral; gradual, smooth boundary.
- A3—9 to 13 inches, very dark grayish-brown (10YR 3/2) heavy silt loam; moderate, very fine, granular structure; friable; many fine roots; strongly acid; gradual, smooth boundary.
- IIB1—13 to 17 inches, dark grayish-brown (10YR 4/2) silty clay loam; few, fine, faint, yellowish-brown (10YR 5/4) mottles; weak, fine, angular blocky structure; firm; many fine roots; strongly acid; gradual, smooth boundary.
- IIB21t—17 to 30 inches, dark grayish-brown (10YR 4/2) silty clay; common, fine, distinct, yellowish-red (5YR 4/6) and few, fine, faint, yellowish-brown (10YR 5/6) mottles; weak, fine subangular blocky and angular blocky structure; very firm; few fine roots; thin continuous clay films; strongly acid; clear, smooth boundary.
- IIB22t—30 to 40 inches, grayish-brown (2.5Y 5/2) clay; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine, subangular blocky structure; very firm; thin continuous clay films; medium acid; gradual, smooth boundary.
- IIB31t—40 to 52 inches, yellowish-brown (10YR 5/6) heavy clay loam; common, medium, distinct, light brownish-gray (2.5Y 6/2) mottles; moderate, fine, subangular blocky structure; firm; thin discontinuous clay films; neutral; gradual, smooth boundary.
- IIB32—52 to 64 inches, yellowish-brown (10YR 5/4) clay loam; few, fine, distinct, light brownish-gray (2.5Y

6/2) mottles; weak, fine, subangular blocky structure; firm; neutral.

The Ap horizon is very dark gray (10YR 3/1) or black (10YR 2/1). It ranges from silt loam to silty clay loam and is 6 to 12 inches thick. The IIB22t horizon commonly contains enough sand to have a gritty feel.

Lamoni soils are closely associated with Armster, Gara, and Kilwinning soils. They are more poorly drained than Armster and Gara soils. They formed in loess and underlying glacial till, whereas Kilwinning soils formed entirely in loess.

Lamoni silt loam, 5 to 9 percent slopes (LcC).—This is a moderately sloping soil in areas, 10 to 50 acres in size, on the sides and at the heads of drainageways and on the sides and tops of ridges. It has the profile described as representative of the series.

Some small areas of Armster and Kilwinning soils are included in mapping. The included Kilwinning soil is adjacent to the upper boundary of areas of this soil, and the included Armster soil is adjacent to the lower boundary. The Armster and Kilwinning soils make up less than 10 percent of the included areas. Approximately 1 percent of this unit is severely eroded. This erosion is designated on the detailed soil map by an erosion spot symbol. Each symbol represents 2 acres.

This Lamoni soil is well suited to all crops in the county. Row crops are grown extensively. Some acreages are used for short term hay plantings. Erosion is the major hazard. Terraces and waterways should be installed if these soils are farmed intensively. Capability unit IIIe-5.

Lamoni silt loam, 9 to 14 percent slopes (LcD).—This is a strongly sloping soil in areas, 3 to 10 acres in size, on the sides and at the heads of drainageways. This soil is mostly in the southwest part of the county.

Included in mapping are small areas of Gara soils adjacent to the lower boundaries of areas of Lamoni soil. They make up less than 10 percent of the mapped area. Some Lamoni silt loam, 5 to 9 percent slopes, eroded, is also included.

Erosion is the major hazard. A protective cover of grass is required most of the time to help prevent further erosion. Capability unit IVe-5.

Lindley Series

The Lindley series consists of deep, moderately slowly permeable, moderately well drained soils on uplands. These soils are strongly sloping to steep. They formed in glacial till under forest vegetation.

In a representative profile the surface layer is very dark grayish-brown, strongly acid loam about 2 inches thick. The subsurface layer is dark grayish-brown, strongly acid loam about 3 inches thick. The subsoil is dark-brown and yellowish-brown loam and clay loam about 41 inches thick. It is strongly acid and very strongly acid in the upper 19 inches, neutral in the next 6 inches, and moderately alkaline in the lower 16 inches. The underlying material is yellowish-brown light clay loam that is moderately alkaline.

Lindley soils have a moderate to high available water capacity. Natural fertility is low. These soils are used for permanent pasture and trees.

Representative profile of Lindley loam, 14 to 20 percent slopes, eroded, in Smith's Roadside Park, 400 feet north of the easternmost picnic fireplace, then 16 feet

southeast of a white oak tree with notch, in SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 9, T. 65 N., R. 10 W.

A1—0 to 2 inches, very dark grayish-brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate, very fine, granular structure; very friable; abundant roots; strongly acid; abrupt, smooth boundary.

A2—2 to 5 inches, dark grayish-brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; moderate, very fine, granular structure; friable; plentiful roots; few fine pebbles; strongly acid; abrupt, smooth boundary.

B1—5 to 7 inches, dark-brown (10YR 4/3) heavy loam; moderate, fine, granular and subangular blocky structure; friable; plentiful roots; few fine pebbles; strongly acid; clear, smooth boundary.

B21t—7 to 11 inches, yellowish-brown (10YR 5/6) light clay loam; moderate, fine and very fine, subangular blocky structure; firm; plentiful roots; few pebbles; thin, discontinuous, dark yellowish-brown (10YR 4/4) clay films; very strongly acid; clear, smooth boundary.

B22t—11 to 24 inches, yellowish-brown (10YR 5/6) heavy clay loam; moderate, fine, angular blocky structure; firm; few roots; few pebbles; thin, continuous, dark yellowish-brown (10YR 4/4) clay films; strongly acid; clear, smooth boundary.

B23t—24 to 30 inches, yellowish-brown (10YR 5/6) clay loam; moderate, fine, subangular blocky structure; firm; few roots; few pebbles; thin, continuous, dark-brown (10YR 4/3) clay films; neutral; clear, smooth boundary.

B3t—30 to 46 inches, yellowish-brown (10YR 5/6) clay loam; few, fine, distinct, light brownish-gray (10YR 6/2) mottles; weak, fine and medium, subangular blocky structure; firm; thin discontinuous clay films; moderately alkaline; gradual, smooth boundary.

C—46 to 62 inches, yellowish-brown (10YR 5/4) light clay loam; common, fine, distinct, light brownish-gray (10YR 6/2) mottles; massive; firm; common, very dark brown, concretionary stains on vertical planes of cleavages and in root channels; few fine roots; common small pebbles; moderately alkaline.

The A1 horizon ranges from very dark gray (10YR 3/1) through dark grayish brown (10YR 4/2) and is 1 to 4 inches thick. The A2 horizon ranges from dark grayish brown (10YR 4/2) through light yellowish brown (10YR 6/4) and is 2 to 7 inches thick. The solum ranges from 30 to about 50 inches in thickness.

Lindley soils have a lighter colored and thinner A1 horizon than the associated Gara soils. They do not have the red colors in the upper part of the B2t horizon that are typical of the associated Armster soils.

Lindley loam, 9 to 14 percent slopes, eroded (LdD2).—This soil is in irregular shaped tracts, 10 to 50 acres in size, at the heads and on the sides of drainageways.

About 10 percent of the acreage mapped as this soil is Lindley loam that has the same slope, but is not eroded. Also included in mapping are areas of Gara and Armster soils that together make up about 10 percent of the acreage.

Most of the acreage has been cleared. This Lindley soil is well suited to hay and pasture. Deep-rooted legumes grow well. The occasional cultivation required for reseeding should be on the contour. Erosion is the major hazard. Capability unit IVe-4.

Lindley loam, 14 to 20 percent slopes, eroded (LdE2).—This soil is in irregular shaped areas, 10 to 40 acres in size, on hillsides.

Small areas of moderately sloping, eroded Gara soils are included with this soil in the areas mapped. About 10 percent of this unit is uneroded, and 6 percent is severely eroded. The severely eroded areas are designated

on the detailed soil map by an erosion spot symbol that represents an area of 2 acres.

This Lindley soil is well suited to permanent pasture. Some areas are still wooded. A topdressing of fertilizer, applications of lime, and controlled grazing help to maintain a good growth of pasture. Mowing helps control brush encroachment. Erosion is the major hazard. Capability unit VIe-4.

Lindley loam, 20 to 30 percent slopes, eroded (LdF2).—This soil is in irregularly shaped areas, 10 to 50 acres in size, on hillsides. It has a profile similar to the one described as representative of the series, but the surface layer is less than 2 inches thick. About 25 percent of this unit is uneroded.

All the acreage of this soil is wooded or is used for pasture. The soil is well suited to these uses. Most areas are too steep for machinery, and for this reason, topdressing with fertilizer, applying lime, and mowing are difficult. Erosion is the major hazard. Capability unit VIIe-4.

Marion Series

The Marion series consists of deep, very slowly permeable, poorly drained soils of the uplands. They formed in loess. The native vegetation was trees.

In a representative profile the surface layer is dark grayish-brown silt loam about 3 inches thick. Reaction is very strongly acid. The subsurface layer is grayish-brown silt loam about 10 inches thick. Reaction is extremely acid. The subsoil is silty clay to a depth of 33 inches. The upper part is dark brown, and the rest is yellowish brown and grayish brown. Reaction is very strongly acid. The lower part of the subsoil is grayish-brown heavy silty clay loam. Reaction is medium acid. The underlying material is slightly acid, grayish-brown heavy silt loam.

Marion soils have moderate to high available water capacity and low inherent fertility.

Most of the acreage of Marion soils is in timber.

Representative profile of Marion silt loam at the first main crossroads east of Highway 15 on Route W, and north of gravel road, one-half mile past first house, 60 feet west of road in northwest corner of NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 19, T. 64 N., R. 11 W.

A1—0 to 3 inches, dark grayish-brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate, very fine, granular structure; friable; common fine and medium roots; very strongly acid; abrupt, smooth boundary.

A2—3 to 13 inches, grayish-brown (10YR 5/2) silt loam, light gray (10YR 7/1) dry; few, fine, faint, yellowish-brown (10YR 5/4) mottles; weak, thick, platy structure parting to moderate, very fine, granular; friable; common fine and medium roots; extremely acid; abrupt, smooth boundary.

B21t—13 to 17 inches, dark-brown (10YR 4/3) silty clay; few, fine, distinct, yellowish-red (5YR 4/6) and few, fine, faint, dark-gray (10YR 4/1) mottles; weak, fine, subangular blocky structure; very firm; common fine and medium roots; thin discontinuous clay films; very strongly acid; gradual, smooth boundary.

B22t—17 to 30 inches, yellowish-brown (10YR 5/4) silty clay; few, fine, faint, grayish-brown (10YR 5/2) mottles; moderate, fine, subangular blocky structure; very firm; common fine and medium roots;

thin discontinuous clay films; very strongly acid; gradual, smooth boundary.

B23t—30 to 33 inches, grayish-brown (10YR 5/2) light silty clay; common, fine, faint, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; firm; few medium roots; thin discontinuous clay films; strongly acid; gradual, smooth boundary.

B3—33 to 43 inches, grayish-brown (2.5Y 5/2) heavy silty clay loam; common, fine, distinct, strong-brown (7.5Y 5/6) and few, fine, distinct, yellowish-red (5YR 5/6) mottles; weak, fine, subangular blocky structure; firm; few fine roots; medium acid; gradual, smooth boundary.

C—43 to 56 inches, grayish-brown (10YR 5/2) heavy silt loam; many, fine, distinct, strong-brown (7.5YR 5/6) mottles; massive; very firm; many small black stains; slightly acid.

The A1 horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2) and ranges in thickness from 1 to 3 inches. The A2 horizon ranges from grayish brown (10YR 5/2) through light brownish gray (10YR 6/2) and in thickness from 6 to 11 inches. Thickness of the solum ranges from 40 to 55 inches. The loess was about 5 feet thick.

Marion soils have an abrupt boundary between the surface layer and the subsoil that distinguishes them from the adjacent, somewhat poorly drained Gorin soils.

Marion silt loam (Mc).—This is a nearly level soil in irregularly shaped areas, 2 to 5 acres in size, in the uplands.

Most of the acreage is wooded or is used for hay or pasture. This soil is not used for row crops or small grain because areas are small. Wetness is the major hazard. Capability unit IIIw-2.

Vigar Series

The Vigar series consists of deep, moderately slowly permeable, gently sloping, moderately well drained soils on the lower parts of slopes. These soils formed in sediments washed down from the adjacent uplands from soils formed in loess and glacial till. The native vegetation was grass.

In a representative profile the surface layer is black loam about 20 inches thick. Reaction is slightly acid in the upper 5 inches and medium acid in the rest. The subsoil is very dark grayish-brown, dark grayish-brown, dark-brown, and dark-gray clay loam about 54 inches thick. Reaction is medium acid.

Vigar soils have high available water capacity and high inherent fertility. They are used for row crops and hay.

Representative profile of Vigar loam, 2 to 5 percent slopes, 0.7 mile south of U.S. Highway 136 at the Granger Junction and 100 feet east of road in pasture, on the north edge of the SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 14, T. 65 N., R. 10 W.

A11—0 to 5 inches, black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate, very fine, granular structure; friable; many fine roots; slightly acid; gradual, smooth boundary.

A12—5 to 20 inches, black (10YR 2/1) loam; moderate, fine, granular structure; friable; many fine roots; many medium sand grains; medium acid; gradual, smooth boundary.

B11—20 to 24 inches, very dark grayish-brown (10YR 3/2) light silty clay loam; weak, fine, subangular blocky structure; firm; many fine roots; medium acid; clear, smooth boundary.

B12—24 to 35 inches, very dark grayish-brown (10YR 3/2) light clay loam; few, fine, faint, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, prismatic structure parting to moderate, fine, sub-

angular blocky; firm; many fine roots; medium acid; clear, smooth boundary.

B21t—35 to 47 inches, dark grayish-brown (10YR 4/2) clay loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, fine, subangular blocky structure; firm; thin discontinuous clay films; medium acid; clear, smooth boundary.

B22t—47 to 60 inches, dark-brown (10YR 4/3) clay loam; few, fine, distinct, dark-gray (10YR 4/1) mottles; moderate, fine, subangular blocky structure; firm; thin discontinuous clay films; medium acid; gradual, smooth boundary.

B3t—60 to 74 inches, mottled dark-brown (10YR 4/3) and dark-gray (10YR 4/1) light clay loam; weak, fine, subangular blocky structure; firm; thin discontinuous clay films; thick clay films in old root channels; medium acid.

In cultivated areas the Ap horizon ranges from black (10YR 2/1) through very dark grayish brown (10YR 3/2). The total A horizon is 10 to 22 inches thick. The lower part is clay loam in some places.

Vigar soils are associated with Arbela and Colo soils. They differ from Arbela soils in not having an A2 horizon. They differ from Colo soils in grading from loam to clay loam, whereas Colo soils are silty clay loam throughout the profile.

Vigar loam, 2 to 5 percent slopes (VgB).—This soil is in irregularly shaped areas, 3 to 35 acres in size, on the lower parts of slopes but above the flood plain. Some narrow areas parallel the steeper slopes of the uplands. Areas of Colo and Arbela soils included in mapping make up less than 5 percent of mapped areas.

This soil is well suited to row crops and meadow. Erosion is the major hazard. Row crops should be planted across the slope. If slopes are long enough, diversion terraces at the base of the uplands help prevent runoff. If slopes are short, terraces are not feasible. Capability unit IIe-2.

Wabash Series

The Wabash series consists of deep, very slowly permeable, very poorly drained soils on the flood plains. These soils are nearly level and are subject to occasional flooding. They formed in alluvium. The native vegetation was water-tolerant grass.

In a representative profile the surface layer is silty clay about 44 inches thick. It is black to a depth of 28 inches and very dark gray below. Reaction is neutral in the upper layer, medium acid in the next layer, and slightly acid in the lower layer. The dark-gray silty clay subsoil, about 31 inches thick, is neutral in reaction. The underlying material is gray sandy clay and is neutral in reaction.

The available water capacity is moderate. Inherent fertility is high. Wabash soils are mostly used for row crops and small grains.

Representative profile of Wabash silty clay 84 feet north from center of U.S. Highway 136, directly north of north entrance to Scotland County Fairgrounds in southwest corner of SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 12, T. 65 N., R. 12 W.

Ap—0 to 8 inches, black (10YR 2/1) silty clay; weak, fine, subangular blocky structure; firm; neutral; gradual, smooth boundary.

A12—8 to 28 inches, black (10YR 2/1) silty clay; common, fine, distinct, light olive-brown (2.5Y 5/6) mottles; weak, fine, subangular and angular blocky structure; very firm; medium acid; gradual, smooth boundary.

A13—28 to 44 inches, very dark gray (N 3/0) silty clay; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, fine, subangular blocky structure to massive; very firm; slightly acid; gradual, smooth boundary.

B21g—44 to 54 inches, dark-gray (N 4/0) silty clay; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine, subangular blocky structure; very firm; neutral; gradual, smooth boundary.

B22g—54 to 75 inches, dark-gray (N 4/0) silty clay; few, fine, distinct, yellowish-brown (10YR 5/6) and few, fine, faint, olive-gray (5Y 5/2) mottles; weak, medium, subangular blocky structure; very firm; neutral; clear, smooth boundary.

C—75 to 86 inches, gray (N 5/0) sandy clay; few, fine, faint, dark yellowish-brown (10YR 4/4) mottles; massive; firm; neutral.

In cultivated areas the Ap horizon is black (10YR 2/1) or very dark gray (10YR 3/1) and is 6 to 8 inches thick. Thickness of the solum ranges from 45 to more than 60 inches.

Wabash soils are finer textured, more poorly drained, and darker in the surface layer than the associated Chequest, Colo, Fatima, and Westerville soils.

Wabash silty clay (Wq).—This soil is in slight depressions, 10 to 100 acres in size, in flood plains midway between the stream channel and the uplands. Areas of Chequest and Colo soils, less than 10 percent of the mapped area, are included in mapping.

This soil is suited to all row crops grown in the county and to small grain, such as wheat. Although this soil is droughty during dry periods, wetness is the major hazard. Drainage ditches should be considered. Capability unit IIIw-14.

Westerville Series

The Westerville series consists of deep, moderately permeable, somewhat poorly drained, nearly level soils. These soils are generally along the main streams on low stream benches, and they are subject to occasional flooding. These soils formed in silty sediments. The native vegetation was trees.

In a representative profile the surface layer is dark grayish-brown silt loam about 9 inches thick. Reaction is strongly acid. The subsurface layer is grayish-brown silt loam about 6 inches thick. Reaction is strongly acid. The subsoil is silt loam and silty clay loam. Colors are dark grayish brown, dark gray, and grayish brown. Reaction is very strongly acid.

Westerville soils have a very high available water capacity. Inherent fertility is moderate to high.

Westerville soils are used for all row crops grown in the county.

Representative profile of Westerville silt loam 600 feet north of South Wyaconda River bridge in the southeast corner of NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 20, T. 66 N., R. 11 W.

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam, brown (10YR 5/3) dry; weak, thick, platy structure parting to moderate, very fine, granular; friable; many fine roots; strongly acid; abrupt, smooth boundary.

A2—9 to 15 inches, grayish-brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; few, fine, distinct, dark-brown (7.5YR 4/4) mottles; weak, medium, platy structure parting to moderate, very fine, granular; friable; many fine roots; strongly acid; abrupt, smooth boundary.

B1—15 to 22 inches, dark grayish-brown (10YR 4/2) silt loam; many, fine, distinct, dark-brown (7.5YR 4/4)

- mottles; weak, very fine, subangular blocky structure; friable; strongly acid; clear, smooth boundary.
- B21—22 to 28 inches, dark grayish-brown (10YR 4/2) heavy silt loam; common, fine, faint, dark-brown (10YR 4/3) mottles; weak, fine, subangular blocky structure; friable; strongly acid; clear, smooth boundary.
- B22—28 to 40 inches, grayish-brown (10YR 5/2) light silty clay loam; common, fine, faint, gray (10YR 5/1) mottles; weak, fine, subangular blocky structure; friable; very strongly acid; gradual, smooth boundary.
- B3g—40 to 64 inches, dark-gray (10YR 4/1) light silty clay loam; few, fine, faint, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable; strongly acid.

The A1 horizon is very dark grayish brown or dark grayish brown. It ranges from 6 to 10 inches in thickness. The A2 horizon, 3 to 6 inches thick, is dark grayish brown or grayish brown. Thickness of the solum ranges from 40 to 65 inches.

Westerville soils are grayer than the associated Fatima soils and are lighter colored than the associated Blackoar soils.

Westerville silt loam (We).—This is a nearly level soil in irregularly shaped areas, 20 to 80 acres in size, on level low stream benches. Included areas of Arbela, Fatima, and Blackoar soils make up less than 10 percent of the mapped area.

Westerville soils are well suited to all row crops and small grain. Wetness is the major hazard. Installing surface drainage ditches should be considered. Capability unit IIw-1.

Use and Management of the Soils

The soils of Scotland County are used mainly for grain and livestock production. This section describes general practices of good soil management for these purposes. It explains the capability grouping used by the Soil Conservation Service and suggests use and management of each soil in the county by capability unit. The capability unit for each soil is shown in the mapping unit description in the section "Description of the Soils" and in the "Guide to Mapping Units."

This part of the survey gives estimated yields of the principal crops, general suggestions for the improvement of wildlife habitat, and information on the suitability of the soils for woodland. Data from engineering tests and interpretations of soil properties that affect highway construction and other engineering structures are shown in tables. Information on use of the soils for recreational facilities is also contained in this section.

Capability Grouping

Capability grouping (10) shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, the kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. These levels are described in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuitable for cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture or range, woodland, wildlife habitat, or recreation.

For some soils, climate and one of the other kinds of limitation have about equal importance, and the subclass symbol shows both kinds; IIce is an example.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-2 or IIIe-5. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Management by capability units

In the following pages the capability units in Scotland County are described, and suggestions for the use and management of the soils are given. Fertilizer and lime should be applied according to soil tests. The soils in each capability unit can be found by referring to "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT I-1

Fatima silt loam is the only soil in this unit. This deep, moderately well drained, nearly level soil is on the bottoms.

The available water capacity of this soil is very high. The organic-matter content is medium to high.

This soil is well suited to corn, soybeans, wheat, and red clover, which are the main crops in the county. Row crops can be grown year after year if crop residue is returned to the soil, fertilizer is applied as needed, tillage is kept at a minimum, and cover crops are used. Otherwise, a suitable cropping system is 3 years of row crops followed by 1 year of small grain seeded with a winter cover crop, which can be turned under for green manure.

CAPABILITY UNIT IIe-2

Vigar loam, 2 to 5 percent slopes, is the only soil in this unit. It is a deep, moderately well drained soil on the lower parts of slopes.

The available water capacity of this soil is high. Permeability is moderately slow. Productivity is high. The content of organic matter is medium.

This soil is well suited to corn, soybeans, wheat, and red clover. Some areas are used for pasture. The main concerns in management are controlling erosion and maintaining fertility and content of organic matter.

A suitable crop rotation is 3 years of row crops followed by 1 year of small grain. Winter cover crops, manure, and crop residue returned to the soil help in maintaining adequate levels of organic matter and fertility. Contour farming helps control erosion. Terraces and waterways are needed if the soil is cultivated often.

CAPABILITY UNIT IIe-5

This unit consists of the deep, gently sloping, somewhat poorly drained Gifford and Kilwinning soils. These soils have a medium-textured surface layer and a fine-textured subsoil.

The available water capacity of these soils is high. Permeability is very slow. Productivity is medium to

high. The organic-matter content is estimated to be medium.

The crops commonly grown are corn, soybeans, wheat, and red clover. The major concerns in management are controlling erosion and maintaining tilth and an adequate level of organic matter and fertility.

Terraces and waterways are needed to help control erosion if row crops are grown (fig. 3). Turning under winter cover crops and adding green manure and crop residue help in maintaining an adequate level of organic matter and in improving tilth.

CAPABILITY UNIT IIw-1

This unit consists of deep, nearly level, somewhat poorly drained and poorly drained Arbela, Blackoar, Chequest, Colo, and Westerville soils. These are soils of the bottoms. Their surface layer is silt loam and silty clay loam.

Available water capacity is high to very high. Estimated permeability is moderate or moderately slow. Surface runoff is slow. Organic-matter content is moderate to high. Productivity is moderately high.

These soils are suited to all crops commonly grown in the county. Corn, soybeans, wheat, and red clover are the major crops. Restricted drainage and the resulting wetness are the main limitations. Occasional overflow is a hazard.

Under highly specialized management, row crops can be grown year after year. Surface drainage, consisting of main and lateral ditches, and in places land grading are needed in removing excess water. Returning crop residue to the soil, fertilizing and liming according to soil tests, and keeping tillage to a minimum are also needed.

CAPABILITY UNIT IIw-2

This unit consists of deep, nearly level, poorly drained Chariton and Edina soils. These soils have a claypan subsoil. Their surface layer is friable silt loam, and their subsurface layer is ashy, friable silt loam. They are on upland divides and high stream benches.

The available water capacity is high. Permeability is very slow and slow. The organic-matter content is medium. Productivity is moderately high.

Crops commonly grown on these soils are corn, soybeans, wheat, and red clover. The major hazard is wetness.

Row crops can be grown year after year if fertilization is adequate, crop residue is returned to the soil, tillage is kept at a minimum, and cover crops are included in the cropping system. Excess water can be removed from these soils by drainage ditches and, in places, by changing row direction of crops. Maintaining good tilth and an adequate level of organic matter is essential.

CAPABILITY UNIT IIIe-5

This unit consists of deep, moderately sloping Armster, Gifford, Gorin, and Lamoni soils. These soils have a medium-textured surface layer and a fine-textured subsoil. They are moderately well drained and somewhat poorly drained. All but Lamoni soils are eroded.

The available water capacity is moderate to high. Permeability is very slow, slow, and moderately slow. Organic-matter content is estimated to be medium.

Crops commonly grown on these soils are corn, soy-



Figure 3.—Crops planted on the contour on parallel terraces. The soil is Kilwinning silt loam, 2 to 5 percent slopes.

beans, wheat, and red clover. Some areas are wooded. Some are used for pasture. The major management concerns are controlling erosion, maintaining an adequate level of organic matter and fertility, and improving tilth.

Terraces and waterways help control runoff and erosion. Winter cover crops, manure, and crop residue returned to the soil help maintain an adequate level of organic matter and improve tilth.

CAPABILITY UNIT IIIw-2

Marion silt loam is the only soil in this unit. It is a deep, nearly level, poorly drained soil on upland divides. It has a surface layer of friable silt loam, a subsurface layer of ashy silt loam, and a claypan subsoil.

The available water capacity is moderate to high. Permeability is very slow. Productivity is low. Organic-matter content is low.

Most of the acreage is wooded. Some areas have been cleared and are used for pasture or hay. Wetness is the major limitation. Removing surface water is not practical because this soil is in such small, irregularly shaped areas.

CAPABILITY UNIT IIIw-14

Wabash silty clay is the only soil in this unit. This deep, very poorly drained, nearly level soil is on flood plains.

The available water capacity is moderate. Permeability is very slow. Organic-matter content is moderate. Productivity is moderately high.

This soil is suited to corn, soybeans, and wheat. Red clover is grown as a green manure crop. Internal wetness is a severe limitation to the use of this soil. Occasional overflow is also a limitation. During dry periods this soil is droughty, and wide cracks form. Other concerns in management are maintaining good tilth and the level of organic matter.

Row crops can be grown year after year if adequate fertilizer is applied, crop residue is returned to the soil, and tillage is kept to a minimum. Surface drainage ditches are needed in removing excess water. Because this soil is slow to dry in spring and has poor tilth, fall plowing is essential. It allows the soil to slack down through the winter.

CAPABILITY UNIT IVe-1

Gara loam, 9 to 14 percent slopes, eroded, the only soil in this unit, is a deep, moderately well drained soil on uplands. It has a medium-textured surface layer and a moderately fine textured subsoil.

The available water capacity is high. Permeability is moderately slow. The organic-matter content is moderate. Productivity is moderate.

This soil is best suited to hay (fig. 4). The major



Figure 4.—Alfalfa hay on Gara loam, 9 to 14 percent slopes, eroded.

management concerns are controlling erosion and maintaining the organic-matter content and fertility.

Small grain can be grown in rotation with meadow hay. Returning residue of the small grain crop helps maintain the organic-matter content and improves tilth.

CAPABILITY UNIT IVe-4

Lindley loam, 9 to 14 percent slopes, eroded, is the only soil in this unit. This is a deep, moderately well drained soil in the uplands. It has a medium-textured surface layer and a moderately fine textured subsoil.

The available water capacity of this soil is high. Permeability is moderately slow. The level of organic matter is low.

This soil is best suited to hay. The major management concerns are controlling erosion and maintaining the organic-matter content and fertility.

Small grain crops can be grown in rotation with meadow hay. Returning residue of the small grain crop to the soil helps maintain the organic-matter content and improves tilth.

CAPABILITY UNIT IVe-5

This unit consists of the strongly sloping Lamoni soils and strongly sloping, eroded Armster soils. These are deep, moderately well drained and somewhat poorly drained soils of the uplands. They have a medium-textured surface layer and a fine-textured subsoil.

These soils have a moderate available water capacity. Permeability is moderately slow and very slow. Productivity is moderate, and the organic-matter content is moderate to low.

The soils of this unit are used mainly for hay. The major management concerns are controlling erosion and maintaining organic-matter content, fertility, and good tilth.

Terraces are needed for erosion control. Growing small grain and returning residue to the soil helps maintain the level of organic matter and improves tilth. Occasional tillage is needed in reestablishing hayland seedings.

CAPABILITY UNIT IVe-7

Alvin fine sandy loam, 5 to 9 percent slopes, is the only soil in this unit. It is deep, well drained to moderately well drained, and moderately coarse textured.

The available water capacity is low to moderate. Permeability is moderately rapid. Productivity is low. The organic-matter content is low.

This soil is best suited to hay or pasture. Erosion is the main limitation. Droughtiness is also a limitation.

Returning all crop residue to the soil conserves moisture, increases the organic-matter content, and helps maintain the level of fertility. Also, minimum tillage helps to conserve moisture. Drought-resistant grasses are essential.

CAPABILITY UNIT VIe-1

Gara loam, 14 to 20 percent slopes, eroded, is the only soil in this unit. It is a deep, moderately well drained soil of the uplands.

The available water capacity is high. Permeability is moderately slow. The organic-matter content is moderate. Productivity is moderate to low.

This soil is best suited to pasture because slopes are steep and erosion is a hazard. Tillage for new seedings should be on the contour as much as possible. Annual topdressing lengthens the life of improved pasture. Overgrazing causes runoff and erosion and thus shortens the life of improved pasture.

CAPABILITY UNIT VIe-4

Lindley loam, 14 to 20 percent slopes, eroded, is the only soil in this unit. It is a deep, moderately well drained soil on uplands. Its surface layer is medium textured, and its subsoil is moderately fine textured.

The available water capacity is moderate to high, and permeability is moderately slow. The level of organic matter is low.

About half the acreage is wooded. The soil is best suited to pasture. The major management concerns are controlling erosion and maintaining organic-matter content and fertility.

Reestablishing grass should be done on the contour. Annual topdressing lengthens the life of improved pasture and increases carrying capacity. Overgrazing causes runoff and erosion and kills improved pasture.

CAPABILITY UNIT VIIe-4

Lindley loam, 20 to 30 percent slopes, eroded, is the only soil in this unit. This is a deep, moderately well drained, moderately slowly permeable soil of the uplands. It has a moderately fine textured subsoil.

The available water capacity is moderate to high. The organic-matter content is low. Productivity is moderately low to low.

Most of the acreage is wooded and needs protection from fire and grazing. Some small areas on less steep slopes are cleared and seeded to pasture. Perennial grasses should be selected for seeding pastures, and an annual topdressing of fertilizer lengthens their life. Overgrazing causes runoff and erosion.

Estimated Yields

The estimated average yields for the principal crops grown in Scotland County are shown in table 2. Yield predictions were made for two levels of management.

For A-level management—

1. At least one-half of the lime and fertilizer, as determined by soil tests, is applied.
2. Crop residue is returned to the soil by leaving stalks, straw, and stubble in the field, by feeding livestock in the field, or by returning all barnyard manure to the soil.

For B-level management—

1. All crop residue is returned to the soil.
2. Fertilizer and lime are applied in amounts indicated by soil tests.

3. Needed soil and water conservation measures are applied.
4. A minimum amount of tillage is done in order to preserve soil structure.
5. Cover crops are used.
6. Cultural practices that include management of grazing, weed and insect control, and timely planting and harvesting are followed.

The absence of a yield figure in the table indicates that the crop is not ordinarily grown on that soil. The yields are estimated averages for a 5- to 10-year period. They do not take into account abnormal seasons or the past management on a particular farm. The yields are based on information received from interviews, Missouri Agricultural Experiment Stations tests, University of Illinois data (12), and technical guides developed by Soil Conservation Service personnel.

Wildlife

With few exceptions, each of the soils in Scotland County can be managed to produce habitat for at least one kind of wildlife. Table 3 shows the degree and kind of limitation of each soil in the county for elements of wildlife habitat and for openland, wetland, and woodland wildlife.

Considered in table 3 are properties that affect the potential of the soil for plant growth and water management, namely, available water capacity, depth, flooding or ponding, slope, and natural drainage.

Each mapping unit is rated *good*, *fair*, *poor*, or *very poor*, according to its potential for each of eight habitat elements. A rating of *good* means that habitat in general is easily created, improved, and maintained; that few or no soil limitations in habitat management exist; and that satisfactory results are well assured. *Fair* means that habitat usually can be created, improved, and maintained; that soil limitations in habitat management are moderate; and that a moderate intensity of management and fairly frequent attention are required to assure satisfactory results. A rating of *poor* means that a habitat can usually be created, improved, and maintained, but management is likely to be difficult, expensive, and require intensive effort, and results are questionable. A *very poor* potential indicates that habitat cannot be created, improved, or maintained; that the management required is impractical under the prevailing soil conditions; and that unsatisfactory results are probable.

Assistance in planning wildlife habitat development is available from technicians assisting the Scotland County Soil and Water Conservation District.

Elements of wildlife habitat

Column headings in table 3 are explained in the paragraphs that follow.

Grain and seed crops are corn, sorghum, millet, soybeans, buckwheat, cowpeas, wheat, oats, barley, rye, and other grains or grainlike seeds consumed by wildlife.

Grasses and legumes are planted grasses and legumes commonly used for forage. Valuable species for wildlife

TABLE 2.—*Estimated average yields per acre of principal crops under two levels of management*

[Figures in columns A are yields to be expected under average management, and those in columns B, under specialized management. Absence of a figure indicates the crop is not commonly grown on the specified soil]

Soil	Corn		Grain sorghum		Wheat		Oats		Soybeans		Rotation hay		Permanent pasture ¹	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Alvin fine sandy loam, 5 to 9 percent slopes	25	45	35	55	10	15	15	25	Bu. 5	15	Tons per acre 1.0	Tons per acre 2.0	Pounds of beef per acre 100	Pounds of beef per acre 200
Arbela silt loam	70	100	50	85	25	50	40	65	25	50	2.0	3.5	200	350
Armster loam, 5 to 9 percent slopes, eroded	40	75	30	55	20	40	25	45	20	40	1.5	3.0	150	350
Armster loam, 9 to 14 percent slopes, eroded	35	70	30	45	10	35	20	45	15	35	1.5	3.0	150	350
Blackoar silt loam	70	100	50	85	25	40	40	60	25	40	2.5	4.0	200	350
Blackoar-Arbela silt loams	60	90	50	85	20	35	40	65	20	40	2.0	3.5	200	350
Chariton silt loam	60	90	50	85	20	35	45	70	25	45	2.0	3.5	150	350
Chequest silty clay loam	70	100	50	70	25	50	40	65	25	40	2.0	3.5	200	300
Colo silty clay loam	70	100	50	70	25	50	40	65	25	40	2.0	3.5	200	300
Edina silt loam	60	90	50	85	20	35	45	70	25	45	2.0	3.5	150	350
Fatima silt loam	80	125	50	85	30	50	45	70	30	50	2.5	4.0	250	400
Gara loam, 9 to 14 percent slopes, eroded	40	70	30	50	15	35	20	35	15	35	1.0	2.0	150	350
Gara loam, 14 to 20 percent slopes, eroded													150	300
Gifford silt loam, 2 to 5 percent slopes	45	75	40	65	20	30	35	45	20	30	2.0	3.5	200	300
Gifford silt loam, 5 to 9 percent slopes, eroded	35	50	25	35	15	25	30	40	15	25	1.5	3.0	150	250
Gorin silt loam, 5 to 9 percent slopes, eroded	40	65	35	55	15	25	25	35	15	25	1.5	2.5	100	250
Kilwinning silt loam, 2 to 5 percent slopes	65	85	40	65	20	40	25	55	20	40	1.5	3.0	200	300
Lamoni silt loam, 5 to 9 percent slopes	45	70	30	55	15	25	20	45	15	25	1.5	3.0	150	300
Lamoni silt loam, 9 to 14 percent slopes													100	250
Lindley loam, 9 to 14 percent slopes, eroded	35	55	30	45	10	15	15	30	10	15	1.0	2.0	150	300
Lindley loam, 14 to 20 percent slopes, eroded													100	250
Lindley loam, 20 to 30 percent slopes, eroded													100	200
Marion silt loam	35	50	25	35	15	25	25	40	15	25	1.5	2.5	150	250
Vigar loam, 2 to 5 percent slopes	60	80	35	55	15	30	40	60	20	40	1.5	3.0	200	350
Wabash silty clay	60	90	50	80	15	30	35	55	30	45	2.0	4.0	200	300
Westerville silt loam	70	100	55	80	25	50	40	60	25	50	2.5	4.0	200	350

¹ Pasture production is expressed in terms of average gain to be expected from yearling steers or heifers grazing for one season on established pasture.

food and cover are lespedezas, alfalfa, alsike clover, Ladino clover, red clover, brome grass, bluegrass, and timothy.

Wild herbaceous upland plants are native annual or perennial herbaceous plants that commonly grow in upland areas. These include the bluestem grasses, indian-grass, switchgrass, and other native grasses; partridge-peas, beggarticks, various native lespedezas, and other native forbs that can be used as food or cover by various kinds of wildlife.

Hardwood woodland plants are the hardwood trees and shrubs that either grow naturally or are planted and produce vigorous growth and large crops of fruit or seed. Included are dogwood, sumac, sassafras, and persimmon; hazelnut, shrub lespedezas, black cherry, autumn-olive, various oaks and hickories; blackberry, bittersweet, coralberry or buckbrush, and blackhaw.

Coniferous woodland plants are native or planted coniferous trees and shrubs. Examples are Scotch pine, red pine, Norway spruce, redcedar, juniper, and arborvitae. Ratings are based on growth rate limitations that produce dense, low foliage and delayed canopy closure.

Wetland food and cover plants provide food and cover for waterfowl and fur-bearing mammals. Examples are smartweed, bulrushes, barnyardgrass, duckweed, pondweed, pickerelweed, cattail, and various sedges.

Shallow water developments are impoundments in which shallow water can be maintained at a desirable

level, preferably 6 to 18 inches and no more than 2 feet above the natural ground level.

Excavated ponds, or dugout ponds, are primarily fish ponds or livestock watering ponds. Migrating waterfowl may be especially attracted to such ponds. These ponds must not depend on runoff from surrounding areas, but such runoff can be beneficial if it is not excessive and does not cause too much silting-in. The water level normally fluctuates with the ground water level.

Farm ponds of the impounded type are not considered in these ratings. As resting areas, they attract migratory waterfowl and can be of great importance in the production of freshwater fish. Information on the suitability of soils for impounded farm ponds is included in the section "Engineering Interpretations."

Kinds of wildlife

The ratings of any particular soil for the kinds of wildlife referred to in table 3 are based on weighted values of the habitat elements considered important to each kind. A weighted average degree of potential for all habitat elements is summarized in the last three columns of table 3.

The ratings for kinds of wildlife indicate in a general way the places where habitat can be managed most practically and with prospects of success.

The ratings also provide an indication of the level of intensity of habitat management necessary for production of wildlife in a given group.

TABLE 3.—*Suitability of soils for elements*

[Absence of entry indicates that the soil

Soil series and map symbols	Elements of wildlife habitat				
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants	Coniferous woody plants
Alvin: AlC-----	Fair: slope-----	Good-----	Good-----	Good-----	Good-----
Arbela: Ar-----	Fair: flooding or ponding; some- what poorly drained.	Good-----	Good-----	Good-----	Good-----
Armster: AsC2, AsD2.	Fair: slope-----	Good-----	Good-----	Good-----	Good-----
Blackoar: Bk, Br-- For Arbela part of Br, see Arbela series.	Poor: poorly drained.	Fair: poorly drained.	Fair: poorly drained.	Fair: poorly drained.	Fair: poorly drained.
Chariton: Ch-----	Poor: poorly drained.	Fair: poorly drained.	Fair: poorly drained.	Fair: poorly drained.	Fair: poorly drained.
Chequest: Cm-----	Poor: poorly drained.	Fair: poorly drained.	Fair: poorly drained.	Fair: poorly drained.	Fair: poorly drained.
Colo: Co-----	Poor: poorly drained.	Fair: poorly drained.	Fair: poorly drained.	Fair: poorly drained.	Good-----
Edina: Ed-----	Poor: poorly drained.	Fair: poorly drained.	Fair: poorly drained.	Fair: poorly drained.	Fair: poorly drained.
Fatima: Fa-----	Good-----	Good-----	Good-----	Good-----	Good-----
Gara: GaD2, GaE2.	Fair: slope-----	Good-----	Good-----	Good-----	Good-----
Gifford: GfB, GfC2.	Fair: somewhat poorly drained.	Good-----	Good-----	Good-----	Good-----
Gorin: GoC2-----	Fair: slope; some- what poorly drained.	Good-----	Good-----	Good-----	Good-----
Kilwinning: KIB--	Fair: somewhat poorly drained.	Good-----	Good-----	Good-----	Good-----
Lamoni: LaC, LaD.	Fair: slope; some- what poorly drained.	Good-----	Good-----	Good-----	Good-----
Lindley: LdD2, LdE2, LdF2.	Poor: slope-----	Good. Fair if slope is more than 14 percent.	Good-----	Good-----	Good-----
Marion: Ma-----	Poor: poorly drained.	Fair: poorly drained.	Fair: poorly drained.	Fair: poorly drained.	Fair: poorly drained.
Vigar: VgB-----	Good-----	Good-----	Good-----	Good-----	Good-----
Wabash: Wa-----	Very poor: very poorly drained.	Poor: very poorly drained.	Poor: very poorly drained.	Poor: very poorly drained.	Poor: very poorly drained.
Westerville: We---	Fair: somewhat poorly drained.	Good-----	Good-----	Good-----	Good-----

of wildlife habitat and kinds of wildlife

is not used for the stated purpose]

Elements of wildlife habitat—Continued			Kinds of wildlife		
Wetland food and cover plants	Shallow water developments	Excavated ponds	Openland wildlife	Woodland wildlife	Wetland wildlife
Poor: slope-----	Very poor: slope---	Very poor: slope---	Good-----	Good-----	Very poor.
Fair: somewhat poorly drained.	Fair: somewhat poorly drained; moderately slow permeability.	Fair: somewhat poorly drained.	Good-----	Good-----	Fair.
Poor: moderately well drained; slopes more than 9 percent.	Very poor: slope---	Very poor: slope---	Good-----	Good-----	Very poor.
Good-----	Good-----	Good-----	Fair-----	Fair-----	Good.
Good-----	Good-----	Good-----	Fair-----	Fair-----	Good.
Good-----	Good-----	Good-----	Fair-----	Fair-----	Good.
Good-----	Good-----	Good-----	Fair-----	Fair-----	Good.
Good-----	Good-----	Good-----	Fair-----	Fair-----	Good.
Poor: moderately well drained.	Poor: moderately well drained.	Poor: moderately well drained.	Good-----	Good-----	Poor.
Very poor: slope---	Very poor: slope---	Very poor: slope---	Good-----	Good-----	Very poor.
Poor: slope-----	Poor: slope-----	Poor: slope-----	Good-----	Good-----	Poor.
Poor: slope-----	Very poor: slope---	Very poor: slope---	Good-----	Good-----	Very poor.
Poor: slope-----	Very poor: slope---	Very poor: slope---	Good-----	Good-----	Very poor.
Very poor: slope---	Very poor: slope---	Very poor: slope---	Good-----	Good-----	Very poor.
Very poor: slope---	Very poor: slope---	Very poor: slope---	Good-----	Good-----	Very poor.
Good-----	Good-----	Good-----	Fair-----	Fair-----	Good.
Poor: moderately well drained.	Poor: moderately well drained.	Poor: moderately well drained.	Good-----	Good-----	Poor.
Poor: silty clay surface layer.	Good-----	Good-----	Poor-----	Poor-----	Fair.
Fair: somewhat poorly drained.	Fair: moderate permeability; somewhat poorly drained.	Poor: moderate permeability.	Good-----	Good-----	Fair.

Openland wildlife refers to birds and mammals that normally frequent cropland, pastures, hayland, and areas overgrown with grasses, herbs, and shrubs. Examples are rabbit, bobwhite quail, red fox, mourning dove, and meadowlark.

Woodland wildlife refers to birds and mammals that normally frequent areas of hardwood trees, coniferous trees, shrubs, or mixtures of such plants. Examples are fox and gray squirrels, whitetail deer, raccoon, skunk, opossum, woodchuck, woodpeckers, nuthatches, vireos, and several kinds of warblers.

Wetland wildlife refers to birds and mammals that normally frequent wet areas, such as ponds, marshes, and swamps. Examples are muskrat, mink, beaver, various kinds of waterfowl, rails, and the kingfisher.

Woodland ²

Scotland County has about 31,400 acres in woodland. It is estimated that originally 40 percent of the county was wooded. The major part of the woodland is in the southern third of the county.

Production of wood crops is minor in the total agricultural program. Barrel staves and hardwood lumber are the primary wood products. In 1965, one stave mill and two sawmills operated in the county (13).

The two general forest types are white oak-hickory on the uplands and mixed hardwoods on the bottom lands. White oak is the most important commercial species on uplands. Black walnut, although the supply is limited, is the most valuable species on bottom lands.

Of the 26 mapping units in Scotland County, only 10 are considered to have potential for growing wood crops.

² ROBERT E. HARTUNG, forester, Soil Conservation Service, helped prepare this section.

Stands of trees do not commonly grow on the other units. The 10 mapping units have been grouped into five woodland suitability groups (3). The soils in each group are about the same in suitability for similar species of trees, management requirements, and potential productivity.

The factors considered in assigning each soil to a woodland group include potential productivity, expressed as site index; species to be preferred for planting; and soil-related hazards and limitations.

Table 4 lists the woodland suitability groups and indicates the potential soil productivity, management problems, and species suitability according to each group. The values are based on field measurement of site index from existing forest stands growing on the indicated soil. Ratings are based on the prepared guides and on the judgment of the soil scientist and forester. They can be used to assist landowners in planning and managing wood crops.

Engineering ³

This section describes the behavior of soils when used as engineering material or as a foundation or cover for various engineering structures. Most of the information is in tables. Table 5 shows engineering test data on samples taken from six soil profiles. Table 6 gives estimated engineering classifications and properties of the soils that affect engineering structures. Table 7 contains information useful to engineers and others who plan to use soil material in the construction of highways, farm facilities, buildings, and sewage disposal systems.

Some soil properties are of special interest to engineers because they affect the construction and maintenance of

³ JOHN F. RICE, agricultural engineer, helped prepare this section.

TABLE 4.—Wood crops and

Woodland group, descriptions of soils, and map symbols	Potential soil productivity		
	Species	Site index ¹	Average annual growth per acre ²
Group 2o2: Deep, somewhat poorly drained and poorly drained, nearly level loamy soils on flood plains. Ar, Bk, We.	Pin oak -----	90	400
Group 4o1: Deep, moderately well drained, sloping loamy soil on uplands----- AsC2.	Upland oak-----	60	190
Group 4r2: Deep, moderately well drained, strongly sloping to steep loamy soils on uplands.. AsD2, LdD2, LdE2, LdF2.	Upland oak-----	60	190
Group 5o1: Deep, somewhat poorly drained, sloping loamy soil, on uplands, that has a loamy or clayey subsoil. GoC2.	Upland oak-----	50	130
Group 5w1: Deep, poorly drained, nearly level loamy soil, on uplands, that has a clayey subsoil. Ma.	Upland oak-----	50	130

¹ Site index curves used: For pin oak, see Broadfoot (2). For upland oak, see Schnur (6).

roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, drainage systems, and sewage disposal systems. The properties most important to the engineer are permeability, shear strength, compaction characteristics, grain size, plasticity, and pH. Depth to bedrock and the water table as well as soil slope are also important. Exact determinations of most of these qualities require laboratory analysis.

The results of the tests of a few key soils in the county were used to make generalized estimates of the engineering properties of all the soils. Because small areas of other soils were included in the mapping units, this information should be considered only as general information. It should be used only for preliminary evaluations of sites for engineering uses. Onsite detailed investigations will be needed for design and final evaluation of sites for specific engineering uses.

This section contains information that can be used to—

1. Make preliminary estimates of the engineering properties of soils in investigating the feasibility of agricultural drainage systems, farm ponds, irrigation systems, dams, and other structures for soil and water conservation and flood control.
2. Make preliminary evaluations of soil and ground conditions that will aid in selecting highway, airport, pipeline, and cable locations and in planning detailed investigations at the selected locations.
3. Aid in selecting industrial, commercial, residential, and recreational sites.
4. Locate probable sources of sand, gravel, or rock for construction use.
5. Supplement the information obtained from other published maps, reports, or aerial photographs

in order to prepare reports that can be readily used by engineers.

6. Determine the suitability of the soils for supporting vehicles and construction equipment.
7. Make preliminary evaluation of the suitability of a particular area for construction purposes.

The engineering interpretations in this section can be useful for many purposes, but it should be emphasized that they will not eliminate the need for sampling and testing of the site of specific engineering works where loads are heavy and where the excavations are deeper than the depths of layers here reported. Even in these situations, however, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Some terms have special meanings in soil science that may not be familiar to engineers. Many of these terms are defined in the Glossary at the back of this survey.

Additional information useful to engineers can be found in other sections of this survey, particularly "Descriptions of the Soils" and "Recreation."

Engineering classification systems

Soil scientists of the U.S. Department of Agriculture classify soils according to texture. USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. Sand, silt, clay, and some of the other terms used in the USDA textural classification are defined in the Glossary of this survey. In some ways, this system of classifying soils is comparable to the systems engineers use in classifying soils. The following paragraphs contain a brief explanation of the soil classification systems used by engineers.

factors in management

Management hazards or limitations					Species to be favored in existing stands	Species preferred for planting
Seedling mortality	Erosion hazard	Windthrow hazard	Plant competition	Equipment restrictions		
Slight.....	Slight.....	Slight.....	Slight.....	Moderate.....	Pin oak, white oak, black cherry, green ash, soft maple, black walnut.	Soft maple, cottonwood, black walnut.
Slight.....	Slight.....	Slight.....	Slight.....	Slight.....	White oak, northern red oak, black oak.	Black walnut, sweetgum, yellow-poplar.
Slight.....	Moderate.....	Slight.....	Slight.....	Slight.....	White oak, northern red oak.	Black walnut (on selected sites), green ash.
Slight.....	Slight.....	Slight.....	Slight.....	Slight.....	White oak, black oak, northern red oak.	Sweetgum, green ash.
Slight.....	Slight.....	Slight.....	Slight.....	Slight.....	White oak, black oak.....	Sweetgum, green ash.

² Board feet, International rule, one-quarter inch.

TABLE 5.—*Engineering*

[Tests made by Missouri State Highway Commission and Bureau of Public Roads (BPR), in accordance

Soil name and location	Parent material	Laboratory number	Depth	Moisture density ¹	
				Maximum dry density	Optimum moisture
Arbela silt loam: 3 miles SE. of Memphis, 1 mile S. of the North Fabius River, SE¼NW¼ sec. 33, T. 65 N., R. 11 W. (The 18- to 30-inch layer is thinner than modal.)	Silty alluvium.	67-4014 67-4015 67-4016	<i>Inches</i> 0-11 18-30 48-82	<i>Lbs. per cu. ft.</i> 98 101 104	<i>Percent</i> 20 19 20
Armster loam: 4 miles N. of Memphis, ¼ mile W. on Route CC, 650 feet N. of road in field, SW¼NW¼ sec. 19, T. 66 N., R. 11 W. (modal)	Glacial till.	67-4005 67-4006 67-4007	0-7 27-38 46-73	103 108 116	18 17 14
Edina silt loam: ¼ mile S. of Iowa line on Highway 15, ¼ mile E. and 350 feet N. of road in field, NW¼NE¼ sec. 29, T. 67 N., R. 11 W. (modal)	Loess.	67-3999 67-4000 67-4001	0-8 18-29 66-88	99 90 108	20 23 17
Gara loam: Approximately 1 mile N. of Crawford on Route B, in bank on E. side of road, NW¼SE¼ sec. 32, T. 66 N., R. 12 W. (modal)	Glacial till.	67-4008 67-4009 67-4010	0-7 14-23 35-60	109 107 111	15 19 15
Kilwinning silt loam: 100 feet S. of SCS office in Memphis, SE¼SE¼ sec. 7, T. 65 N., R. 11 W. (modal)	Loess.	67-4002 67-4003 67-4004	0-8 15-28 56-74	99 92 115	20 25 14
Lindley loam: Wooded area approximately 1½ miles E. of Highway 15 on Route W, 400 feet N. of Route W, SE¼SW¼ sec. 24, T. 64 N., R. 12 W. (modal)	Glacial till.	67-4011 67-4012 67-4013	2-4 14-28 40-56	118 108 117	11 17 14

¹ Based on AASHO Desigination: T99-57 Method C (1).² Mechanical analysis according to the American Association of State Highway Officials T88-57(1). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and various grain-sized fractions are calculated on the basis of all the material including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the

test data

with standard procedures of American Association of State Highway Officials (AASHO) (1)]

Mechanical analysis ²					Liquid limit	Plasticity index	Classification	
Percentage passing sieve—			Percentage smaller than—				AASHO	Unified ³
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.005 mm.	0.001 mm.				
100	98	92	28	13	35	11	A-6(8)	CL
100	99	94	38	24	38	20	A-6(12)	CL
100	100	98	47	29	50	31	A-7-6(18)	CL
99	93	71	29	17	34	14	A-6(9)	CL
99	93	71	45	31	49	32	A-7-6(17)	CL
98	91	60	34	23	34	20	A-6(9)	CL
100	97	95	27	9	34	7	A-4(8)	CL
100	99	66	47	68	40	40	A-7-6(20)	CL
100	98	92	39	22	36	19	A-6(12)	CL
94	85	53	20	9	32	14	A-6(5)	CL
100	94	72	48	34	48	30	A-7-6(17)	CL
100	92	68	38	28	38	22	A-6(12)	CL
100	98	95	29	11	35	11	A-6(8)	CL
100	100	99	61	51	63	38	A-7-6(20)	CH
100	96	83	32	16	30	15	A-6(10)	CL
98	90	59	16	7	22	4	A-4(5)	CL-ML
99	92	67	38	29	39	23	A-6(11)	CL
100	91	60	28	14	30	16	A-6(7)	CL

material coarser than 2 millimeters in diameter is excluded from calculations of grain-sized fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

³ SCS and BPR have agreed to consider that all soils having plasticity indexes within two points of A-line are to be given a borderline classification. An example of a borderline classification obtained by this use is CL-ML.

TABLE 6.—*Estimates of soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in for referring to other series that appear in the first column of

Soil series and symbols	Depth to seasonal high water table	Depth from surface	Classification		
			USDA texture	Unified	AASHO
Alvin: A1C	Feet >5	Inches 0-12 12-36 36-64	Fine sandy loam Sandy loam..... Loamy sand	SM or ML SM SM	A-4 A-2-4 or A-4 A-2-4
Arbela: Ar	10	0-22 22-68	Silt loam..... Silty clay loam.....	ML or CL CL	A-4 or A-6 A-6 or A-7
Armster: AsC2, AsD2.....	>5	0-10 10-70	Loam..... Clay loam.....	ML or CL CL	A-4 or A-6 A-7
*Blackoar: Bk, Br	10	0-70	Silt loam	ML	A-4
For Arbela part of Br, see Arbela series.					
Chariton: Ch	>5	0-18 18-50 50-71	Silt loam	ML	A-4
			Silty clay	CH	A-7
			Very fine sandy clay loam	CL	A-4 or A-6
Chequest: Cm	10	0-60	Silty clay loam.....	CL or CH	A-6 or A-7
Colo: Co	10	0-78	Silty clay loam.....	CL or CH	A-6 or A-7
Edina: Ed	>5	0-18 18-54 54-70	Silt loam	ML	A-4
			Silty clay	CH	A-7-6
			Silty clay loam.....	CL or CH	A-6 or A-7
Fatima: Fa	10	0-64	Silt loam	ML	A-4
Gara: GaD2, GaE2.....	>5	0-10 10-52	Loam..... Clay loam.....	ML CL or CH	A-4 A-7
Gifford: GfB, GfC2.....	>5	0-7 7-17 17-32 32-50	Silt loam	ML	A-4
			Silty clay loam.....	CL	A-6 or A-7
			Silty clay	CH	A-7
			Silty clay loam.....	CL	A-6 or A-7
Gorin: GoC2.....	>5	0-3 3-15 15-32 32-53	Silt loam	ML	A-4
			Silty clay loam.....	ML or CL	A-4 or A-6
			Silty clay	CH	A-7
			Silty clay loam.....	CL	A-6
Kilwinning: K1B.....	>5	0-8 8-30 30-65	Silt loam	ML or CL	A-4 or A-6
			Silty clay	CH	A-7
			Silty clay loam.....	CL	A-6
Lamoni: LaC, LaD.....	>5	0-13 13-40 40-64	Silt loam	ML or CL	A-4 or A-6
			Silty clay	CH	A-7
			Clay loam.....	CL	A-7
Lindley: LdD2, LdE2, LdF2.....	>5	0-7 7-62	Loam..... Clay loam.....	ML-CL CL	A-4 A-7
Marion: Ma	>5	0-13 13-33 33-56	Silt loam	ML	A-4
			Silty clay	CH	A-7
			Silty clay loam.....	CL	A-6 or A-7
Vigar: VgB	3-5	0-20 20-74	Loam..... Clay loam.....	ML CL	A-4 A-7
Wasbash: Wa	10	0-75	Silty clay	CH	A-7
Westerville: We	10	0-22 22-64	Silt loam	ML	A-4
			Silty clay loam.....	CL	A-6

¹ Subject to flooding.

significant in engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions this table. > signifies greater than, and < less than]

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4	No. 10	No. 40	No. 200				
100	95-100	70-85	40-55	<i>Inches per hour</i> 2.0-6.3	<i>Inches per inch of soil</i> 0.16-0.18	<i>pH</i> 6.1-6.5	Very low.
100	95-100	60-70	30-40	2.0-6.3	0.10-0.14	5.6-6.0	Very low.
100	95-100	50-75	15-30	6.3-10.0	0.09-0.10	5.6-6.0	Very low.
100	95-100	90-95	80-95	0.6-2.0	0.22-0.24	5.1-7.3	Low.
100	95-100	90-100	85-95	0.2-0.6	0.17-0.19	5.1-6.5	Moderate.
100	95-100	90-95	60-75	0.6-2.0	0.16-0.18	6.1-6.5	Low.
100	95-100	90-100	60-80	0.2-0.6	0.15-0.18	4.5-6.5	Moderate to high.
100	95-100	90-95	70-90	0.6-2.0	0.20-0.23	6.6-7.3	Low.
100	95-100	90-95	70-90	0.6-2.0	0.22-0.24	5.1-7.3	Low.
100	95-100	95-100	90-95	0.06-0.20	0.11-0.13	5.6-7.3	Very high.
100	95-100	85-95	50-65	0.6-2.0	0.14-0.17	7.4-7.8	Low.
100	95-100	90-100	85-95	0.2-0.6	0.18-0.21	5.1-6.0	High.
100	95-100	90-100	85-95	0.2-0.6	0.18-0.21	6.1-7.3	High.
100	95-100	90-95	85-95	0.6-2.0	0.22-0.24	5.6-7.3	Low.
100	95-100	95-100	90-100	<0.06	0.11-0.13	5.6-7.3	Very high.
100	95-100	90-100	85-95	0.2-0.6	0.18-0.20	6.6-7.3	High.
100	95-100	90-95	70-90	0.6-2.0	0.22-0.24	6.1-7.3	Low.
100	95-100	85-95	50-65	0.6-2.0	0.20-0.22	5.1-6.5	Low.
100	95-100	80-95	70-80	0.2-0.6	0.16-0.18	5.1-7.8	Moderate to high.
100	95-100	90-95	70-90	0.63-2.0	0.22-0.24	6.1-6.5	Low.
100	95-100	90-100	85-95	0.2-0.63	0.18-0.20	5.1-5.5	Moderate.
100	95-100	95-100	90-95	<0.6	0.10-0.12	5.1-6.0	High.
100	95-100	90-100	85-95	0.2-0.63	0.18-0.21	6.6-7.3	Moderate.
100	95-100	90-95	70-90	0.63-2.0	0.22-0.24	6.6-7.3	Low.
100	95-100	90-100	85-95	0.2-0.63	0.18-0.20	5.1-5.5	Moderate.
100	95-100	95-100	90-95	0.63-0.20	0.10-0.12	5.1-5.5	High.
100	95-100	90-100	85-95	0.2-0.63	0.15-0.18	5.6-6.0	Moderate.
100	95-100	90-100	75-95	0.63-2.0	0.22-0.24	5.6-6.0	Low.
100	95-100	95-100	90-100	<0.0-0.06	0.11-0.13	5.6-6.0	High.
100	95-100	90-100	85-95	0.2-0.63	0.18-0.20	6.6-7.3	Moderate.
100	95-100	90-95	70-90	0.63-2.0	0.22-0.24	5.6-6.0	Low.
100	95-100	95-100	90-95	<0.06	0.11-0.13	5.1-5.5	High.
100	95-100	80-95	70-80	0.2-0.63	0.14-0.16	6.1-6.5	Moderate to high.
100	95-100	90-95	55-75	0.6-2.0	0.20-0.22	5.1-5.5	Low.
100	95-100	80-95	65-75	0.2-0.6	0.16-0.18	4.5-7.3	Moderate.
100	95-100	90-95	70-90	0.6-2.0	0.19-0.23	4.5-5.5	Low.
100	95-100	95-100	90-95	<0.06	0.11-0.13	4.5-5.5	High.
100	95-100	90-100	85-95	0.2-0.6	0.18-0.20	6.1-6.5	Moderate.
100	95-100	90-95	60-75	0.6-2.0	0.20-0.22	5.6-6.5	Low.
100	95-100	80-95	70-80	0.2-0.6	0.16-0.18	5.6-6.0	Moderate to high.
100	95-100	95-100	90-95	<0.06	0.11-0.13	5.6-7.3	Very high.
100	95-100	90-95	70-90	0.6-2.0	0.22-0.24	5.1-5.5	Low.
100	95-100	90-100	85-95	0.6-2.0	0.18-0.20	4.5-5.5	Moderate.

TABLE 7.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils for referring to other series that

Soil series and map symbols	Degree and kind of limitation for—					Suitability as source of—
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Sanitary landfill (trench type) ¹	Local roads and streets	Road fill
Alvin: AIC-----	None to slight---	Severe: moderately rapid permeability.	None to slight---	Severe: permeability more than 2.0 inches per hour.	None to slight---	Good: very low shrink-swell potential; moderately well drained.
Arbela: Ar-----	Severe: moderately slow permeability; subject to flooding.	Severe: subject to flooding.	Severe: somewhat poorly drained; subject to flooding.	Severe: seasonal water table at a depth of less than 60 inches; subject to flooding.	Severe: CL; flooding more than once in 5 years.	Fair to poor: somewhat poorly drained; plasticity index more than 15.
Armster: AsC2-----	Severe: moderately slow permeability.	Moderate: sloping.	Moderate: moderately well drained.	Moderate: clay loam texture.	Severe: plasticity index more than 15.	Fair to poor: plasticity index more than 15; moderate to high shrink-swell potential.
AsD2-----	Severe: moderately slow permeability.	Severe: strongly sloping.	Moderate: moderately well drained.	Moderate: clay loam texture.	Severe: plasticity index more than 15.	Fair to poor: plasticity index more than 15; moderate to high shrink-swell potential.
*Blackoar: Bk, Br. For Arbela part of Br, see Arbela series.	Severe: seasonal water table at a depth of less than 60 inches; subject to flooding.	Severe: subject to flooding.	Severe: poorly drained; subject to flooding.	Severe: seasonal water table at a depth of less than 60 inches; poorly drained.	Severe: poorly drained; floods more than once in 5 years.	Poor: poorly drained.
Chariton: Ch---	Severe: slow permeability.	None to slight---	Severe: poorly drained.	Severe: poorly drained.	Severe: poorly drained; high shrink-swell potential.	Poor: poorly drained; plasticity index more than 15.
Chequest: Cn---	Severe: moderately slow permeability; subject to flooding.	Severe: subject to flooding.	Severe: poorly drained; subject to flooding.	Severe: poorly drained; subject to flooding.	Severe: poorly drained; flooding less than once in 5 years.	Poor: poorly drained.
Colo: Co-----	Severe: moderately slow permeability; subject to flooding.	Severe: subject to flooding.	Severe: poorly drained; subject to flooding.	Severe: seasonal water table at a depth of less than 60 inches; subject to flooding.	Severe: poorly drained; floods less than once in 5 years.	Poor: poorly drained.

See footnote at end of table.

interpretations

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions appear in the first column of this table]

Suitability as source of—Con.	Soil features affecting—					
Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions	Grassed waterways
Good: more than 6 inches of friable fine sandy loam and sandy loam available.	Moderately rapid permeability and seepage.	Sandy material; moderate seepage rate; poor resistance to piping.	Practice not applicable on this soil.	Moderate available water capacity.	Irregular slopes---	Moderate available water capacity; difficult to vegetate.
Fair: surface layer is 11 inches thick.	Seasonal high water table.	Fair to poor compaction characteristics.	Moderately slow permeability; seasonal high water table.	Moderate intake rate; susceptible to flooding.	Practice not applicable on this soil.	Practice not applicable on this soil.
Fair: surface layer is 10 inches thick.	Sand pockets in some places.	Fair to good compaction characteristics; low permeability if compacted.	Practice not applicable on this soil.	Moderate intake rate; moderately sloping.	Susceptible to water erosion and siltation.	Clay loam subsoil difficult to vegetate.
Fair: surface layer is 10 inches thick.	Sand pockets in some places.	Fair to good compaction characteristics; low permeability if compacted.	Practice not applicable on this soil.	Moderate intake rate; strongly sloping.	Strongly sloping--	Clay loam subsoil difficult to vegetate.
Poor: poorly drained.	Seasonal water table at a depth of less than 60 inches.	Poor compaction characteristics; poor stability.	Seasonal water table at a depth of less than 60 inches; subject to flooding.	Moderate intake rate; seasonal water table at a depth of less than 60 inches; subject to flooding.	Practice not applicable on this soil.	Practice not applicable on this soil.
Poor: poorly drained.	Slowly permeable; nearly level soils; restricted storage potential; dugout reservoirs required.	Fair to poor stability and compaction characteristics.	Slowly permeable.	Slow intake rate; poorly drained.	Practice not applicable on this soil.	Practice not applicable on this soil.
Poor: poorly drained.	Seasonal water table at a depth of less than 60 inches.	Fair to good stability and compaction characteristics.	Moderately slow permeability; subject to flooding.	Slow intake rate; poorly drained.	Practice not applicable on this soil.	Practice not applicable on this soil.
Poor: poorly drained.	Seasonal water table at a depth of less than 60 inches.	Fair to good stability and compaction characteristics.	Moderately slow permeability; subject to flooding.	Slow intake rate; poorly drained.	Practice not applicable on this soil.	Practice not applicable on this soil.

TABLE 7.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					Suitability as source of—
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Sanitary landfill (trench type) ¹	Local roads and streets	Road fill
Edina: Ed-----	Severe: very slow permeability; seasonal water table at a depth of 24 inches.	None to slight---	Severe: poorly drained; seasonal water table at a depth of 24 inches.	Severe: poorly drained.	Severe: poorly drained; high shrink-swell potential.	Poor: poorly drained; high shrink-swell potential.
Fatima: Fa-----	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: floods less than once in 5 years.	Fair: M.L. Unified Classification.
Gara: GaD2-----	Severe: moderately slow permeability.	Severe: strongly sloping.	Moderate: moderately well drained; strongly sloping.	None to slight-----	Moderate: erodible cut slopes; moderate to high shrink-swell potential.	Fair: CL or CH; moderate to high shrink-swell potential.
GaE2-----	Severe: moderately slow permeability.	Severe: moderately steep.	Severe: moderately steep; moderately well drained.	None to slight-----	Moderate: erodible cut slopes; moderate to high shrink-swell potential.	Fair: CL or CH; moderate to high shrink-swell potential.
Gifford: GfB-----	Severe: very slow permeability.	Moderate: gently sloping.	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: CH Unified Classification in subsoil; high shrink-swell potential in subsoil.	Poor: CH Unified Classification in subsoil; high shrink-swell potential.
GfC2-----	Severe: very slow permeability.	Moderate: sloping.	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: CH Unified Classification in subsoil; high shrink-swell potential in subsoil.	Poor: CH Unified Classification in subsoil; high shrink-swell potential.
Gorin: GoC2---	Severe: slow permeability.	Moderate: sloping.	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: high shrink-swell potential in subsoil.	Fair: somewhat poorly drained.
Kilwinning: KIB.	Severe: very slow permeability.	Moderate: gently sloping.	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: high shrink-swell potential in subsoil.	Poor: high shrink-swell potential in subsoil.
Lamoni: LaC-----	Severe: very slow permeability.	Moderate: sloping.	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: high shrink-swell potential.	Poor: high shrink-swell potential in subsoil.

See footnote at end of table.

interpretations—Continued

Suitability as source of—Con.	Soil features affecting—					
Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions	Grassed waterways
Poor: poorly drained.	Very slowly permeable; nearly level soils; restricted storage potential; dugout reservoirs required.	Fair to poor stability and compaction characteristics.	Very slowly permeable.	Very slow intake rate of subsoil.	Practice not applicable on this soil.	Practice not applicable on this soil.
Good: friable; silt loam texture; less than 16 inches of material.	Moderate permeability; susceptible to seepage.	Poor resistance to piping and poor compaction characteristics.	Subject to occasional flooding; moderately permeable.	Good intake rate.	Practice not applicable on this soil.	Practice not applicable on this soil.
Fair: combined thickness of surface and subsurface layers is 10 inches.	Sand pockets occur in some places.	Fair to good stability and compaction characteristics.	Practice not applicable on this soil.	Moderate intake rate; strongly sloping.	Susceptible to siltation; strongly sloping; not feasible.	Clay loam subsoil; difficult to vegetate; strongly sloping.
Fair: combined thickness of surface and subsurface layers is 10 inches.	Sand pockets occur in some places.	Fair to good stability and compaction characteristics.	Practice not applicable on this soil.	Not feasible; moderately steep.	Not feasible; moderately steep.	Not feasible; moderately steep.
Fair: combined thickness of surface and subsurface layers is 11 inches.	Very slow permeability.	Fair to poor stability and compaction characteristics.	Practice not applicable on this soil.	Slow intake rate in subsoil.	Slopes usually too short.	Dense, clayey subsoil; difficult to vegetate.
Fair: combined thickness of surface and subsurface layers is 11 inches.	Very slow permeability.	Fair to poor stability and compaction characteristics.	Practice not applicable on this soil.	Slow intake rate in subsoil.	Slopes usually too short.	Dense, clayey subsoil; difficult to vegetate.
Fair: combined thickness of surface and subsurface layers is 9 inches.	Slow permeability.	Fair to poor stability and compaction characteristics.	Practice not applicable on this soil.	Sloping; hazard of water erosion.	Potential siltation of channels.	Clayey subsoil; difficult to vegetate.
Fair: surface layer about 8 inches thick.	Very slow permeability; gently sloping soils; restricted storage potential; dugout reservoirs required.	Fair to poor stability and compaction characteristics.	Practice not applicable on this soil.	Gently sloping; slow intake rate in subsoil; hazard of water erosion.	Potential siltation of channel; uniform slopes.	Clayey subsoil; difficult to vegetate.
Fair: combined thickness of surface and subsurface layers is 13 inches.	Very slow permeability.	Fair to poor stability and compaction characteristics.	Practice not applicable on this soil.	Sloping; slow intake rate in subsoil; hazard of water erosion.	Potential siltation of channel; uniform slopes.	Clayey subsoil; difficult to vegetate.

TABLE 7.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					Suitability as source of—
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Sanitary landfill (trench type) ¹	Local roads and streets	Road fill
Lamoni—Con. LaD-----	Severe: very slow permeability.	Severe: strongly sloping.	Moderate: strongly sloping.	Moderate: somewhat poorly drained.	Severe: high shrink-swell potential.	Poor: high shrink-swell potential in subsoil.
Lindley: LdD2-----	Severe: moderately slow permeability.	Severe: strongly sloping.	Moderate: moderately well drained; strongly sloping.	Moderate: dominant soil texture to 60 inches is clay loam.	Moderate: strongly sloping; moderate shrink-swell potential.	Fair: CL Unified Classification; moderate shrink-swell potential.
LdE2-----	Severe: moderately slow permeability.	Severe: moderately steep.	Severe: moderately steep.	Moderate: dominant soil texture to 60 inches is clay loam.	Severe: moderately steep.	Fair: CL Unified Classification; moderate shrink-swell potential.
LdF2-----	Severe: moderately slow permeability.	Severe: steep--	Severe: steep--	Moderate: dominant soil texture to 60 inches is clay loam.	Severe: steep----	Fair: CL Unified Classification; moderate shrink-swell potential.
Marion: Ma---	Severe: very slow permeability.	None to slight--	Severe: poorly drained.	Severe: poorly drained.	Severe: poorly drained; CH Unified Classification of subsoil; high shrink-swell potential.	Poor: high shrink-swell potential in subsoil; poorly drained.
Vigar: VgB----	Severe: moderately slow permeability.	Moderate: gently sloping.	Moderate: moderately well drained.	Moderate: dominant textures to depth of 60 inches are clay loam and silty clay loam.	Moderate: moderate to high shrink-swell potential.	Moderate: moderate to high shrink-swell potential.
Wabash: Wa---	Severe: very slow permeability.	Severe: subject to flooding.	Severe: very poorly drained; subject to flooding.	Severe: very poorly drained; subject to flooding; dominant texture to depth of 60 inches is silty clay.	Severe: very poorly drained; floods more than once in 5 years; very high shrink-swell potential.	Poor: CH Unified Classification; very high shrink-swell potential; very poorly drained.
Westerville: We---	Severe: subject to flooding.	Severe: subject to flooding.	Severe: somewhat poorly drained; subject to flooding.	Severe: subject to flooding.	Moderate: somewhat poorly drained; moderate shrink-swell potential.	Fair: moderate shrink-swell potential; somewhat poorly drained.

¹ Onsite study is needed of the underlying strata, the water table, and the hazards of aquifer pollution and drainage into ground water

interpretations—Continued

Suitability as source of—Con.	Soil features affecting—					
Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions	Grassed waterways
Fair: combined thickness of surface and subsurface layers is about 13 inches; strongly sloping.	Very slow permeability.	Fair to poor stability and compaction characteristics.	Practice not applicable on this soil.	Strongly sloping; not feasible.	Not feasible; strongly sloping.	Clayey subsoil; difficult to vegetate.
Poor: surface and subsurface layers combined are about 5 inches thick.	Moderately slow permeability.	Low permeability when compacted; fair to good stability.	Practice not applicable on this soil.	Strongly sloping; not feasible.	Strongly sloping; not feasible.	Clay loam subsoil; difficult to vegetate.
Poor: surface and subsurface layers combined are about 5 inches thick.	Moderately slow permeability.	Low permeability when compacted; fair to good stability.	Practice not applicable on this soil.	Moderately steep; not feasible.	Moderately steep; not feasible.	Moderately steep; not feasible.
Poor: surface and subsurface layers combined are about 5 inches thick.	Moderately slow permeability.	Low permeability when compacted; fair to good stability.	Practice not applicable on this soil.	Steep: not feasible.	Steep: not feasible.	Steep: not feasible.
Poor: surface layer is about 3 inches thick; poorly drained.	Very slow permeability; nearly level soils; restricted storage potential; dug-out reservoirs required.	Fair to poor stability and compaction characteristics.	Very slow permeability; some areas of low spots.	Slow intake rate in subsoil.	Practice not applicable on this soil.	Practice not applicable on this soil.
Good: more than 16 inches friable loam material.	Gently sloping soils; restricted storage potential; dug-out reservoirs required.	Low permeability when compacted; fair to good stability.	Practice not applicable on this soil.	Moderate intake rate; hazard of water erosion.	Slopes usually too short to be feasible.	Moderately erodible.
Poor: silty clay texture; very poorly drained.	Seasonal water table at a depth of 30 inches; nearly level soils; restricted storage potential; dug-out reservoirs required.	Clayey material; poor compaction characteristics.	Subject to overflow; very slow permeability.	Very slow intake rate.	Practice not applicable on this soil.	Practice not applicable on this soil.
Good: more than 16 inches of friable silt loam material.	Moderate permeability; nearly level soils; restricted storage potential; dug-out reservoirs required.	Susceptible to piping; fair stability.	Subject to flooding; moderate permeability.	Moderate intake rate.	Practice not applicable on this soil.	Practice not applicable on this soil.

in landfill deeper than 5 or 6 feet.

Most highway engineers classify soil material in accordance with the American Association of State Highway Officials (AASHO) (1). There are seven principal groups into which soil materials are classified in this system. These groups range from A-1, which consists of gravelly soils of high bearing capacity, to A-7, which consists of clayey soils having low strength when wet. Within each of the principal groups, the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best material to 20 for the poorest. The group index number is shown in parentheses following the soil group symbol.

Some engineers prefer to use the Unified system (11), (4). In the Unified system, soil materials are identified as coarse grained, eight classes; fine grained, six classes; and highly organic. Within these classes two letters (for example, ML) are used to indicate the kind of soil material and to designate each soil group. The letters used to indicate kinds of soil material are G, S, M, and C, which stand for gravel, sand, nonplastic fines, and plastic fines, respectively. The letter O is used to indicate silt or clay that has a high content of organic matter.

The letters W, P, L, and H stand for well-graded, poorly graded, low liquid limit, and high liquid limit, respectively.

In a symbol indicating two soil separates, for example, SM for sand and nonplastic fines, the first letter indicates the dominant soil separate. Soils on the borderline between two classifications are given a joint classification, for example, GP-GM.

Engineering test data

Table 5 contains the results of engineering tests performed by the Division of Materials and Research, Missouri State Highway Commission. Tests were made on six important soils in Scotland County. The table shows the specific location where samples were taken, the depth to which the sampling was done, and the results of tests that determine particle-size distribution and other properties significant in soil engineering. Some of the other properties are moisture density, liquid limit, and plasticity index.

In the moisture density test, a soil is compacted at successively higher moisture content. Assuming the compactive effort remains constant, the density of the compacted material increases until the optimum moisture content is reached; after that the density decreases with an increase in moisture. The highest dry density obtained in the compaction test is called the maximum dry density. Moisture density data are important in earthwork because the soil is most stable if it is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

The tests for liquid limit and plastic limit measure the effect of water on the consistency of the soil material. As moisture is increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content, expressed as a percentage of the oven-dry weight of the soil, at which the material passes from semisolid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. Between the liquid limit and the plastic limit is a

numerical difference called the plasticity index. This index expresses the range of moisture content within which a soil acts as a plastic material. Some silty and sandy soils are nonplastic; that is, not plastic at any moisture content.

Estimates of soil properties significant in engineering

Table 6 gives the estimated physical and chemical properties significant in engineering for the soils of Scotland County. Engineering test data shown in table 5, together with other information collected during the survey, and experience with the same or similar soils in other counties were used as the basis for these estimates. An explanation of some of these properties in table 6 follows.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material. Sand, silt, and clay are defined in the Glossary at the back of this survey.

Permeability refers to the rate at which water moves downward through the soil material in its undisturbed state. This does not include lateral seepage.

Available water capacity is the capacity of the soil to hold water than can be used by plants.

Reaction is the degree of acidity or alkalinity of a soil expressed as a pH value. The pH value, and relative terms used to describe soil reaction, are explained in the Glossary.

Shrink-swell potential is an indication of the volume change to be expected with a change in moisture content. It is estimated primarily on the basis of the amount and type of clay.

Engineering interpretations

Table 7 contains information useful to engineers and others who plan to use soil material in construction of highways, farm facilities, buildings, and sewage disposal systems. Detrimental or undesirable features also may be listed. The ratings and other interpretations in this table are based on estimated engineering properties of the soils in table 6, on available test data in table 5, and on field experience.

Some of the uses to be rated, a definition of some of the uses, and an explanation of the key soil features that affect these uses follow.

Septic tank absorption fields are affected mainly by permeability, location of water table, susceptibility to flooding, and soil slope.

Sewage lagoons are influenced chiefly by soil features, such as permeability, depth of water table, susceptibility to flooding, and slope.

Shallow excavations are less than 6 feet deep. They refer to those made for basements, ditches, graves, underground cables, pipelines, and sewerlines.

Sanitary landfill (trench type) is a dug trench in which refuse is buried. The refuse is covered with at least a 6-inch layer of compacted soil material daily.

Local roads and streets are influenced by features of the undisturbed soil that would affect construction and maintenance of highways. The soil features, favorable as well as unfavorable, are the principal ones that affect geographic location of highways.

Road fill is material used to build embankments. The ratings indicate performance of soil material moved from borrow areas for these purposes.

Topsoil is a term used to designate a fertile soil or soil material, ordinarily rich in organic matter. The ratings indicate suitability for such use.

Pond reservoir areas are affected mainly by seepage loss of water, and the soil features are those that influence such seepage.

Embankments, dikes, and levees are low structures designed to impound or divert water. The soil features are those that affect use of soil as material for constructing low dikes and levees.

Drainage of cropland and pasture is affected by natural drainage and soil permeability.

Irrigation is affected by soil permeability, topography, and available water capacity.

Terraces, diversions, and waterways are affected by permeability; topography; and nature of soil material, particularly material in the subsoil.

Engineering, general

Soils of Scotland County are moderately slowly to very slowly permeable. Many acres are subject to flooding and have strongly sloping to steep soils. Depth to bedrock is well below depths to which soils generally were investigated in field mapping. These features and properties will have a large influence on the use of soils for engineering. Soils of Scotland County are not suitable sources of sand and gravel.

Recreation

Table 8 shows the degree and kind of limitations of the soils of Scotland County for selected recreational uses. In general, the same soil properties that affect the use of soils for farming are the ones that affect their use for recreation. For example, frequent flooding presents a serious limitation for use as sites for camping and most recreational buildings. Where flooding is infrequent, the use for hiking trails or nature study areas may be only partly limited. Soils that are wet for much of the season of use, even if not subject to flooding, are not well suited to campsites, paths and trails, playgrounds, golf fairways, and picnic areas.

Droughty soils are limited because they cannot support plant life during dry periods. Silty soils can be excessively dusty, and clayey soils, sticky and slippery after rains.

Slope also affects the use of soils for recreational facilities. Steep slopes normally present severe hazards for most types of recreational uses. Nearly level, well-drained soils that do not flood generally have the fewest limitations for recreational use.

The soil properties considered in planning recreational facilities are wetness, as indicated by soil drainage, tendency toward ponding, presence of a high water table, and estimated frequency of flooding; permeability, as indicated by such soil properties and features as texture, structure, and color; surface texture; and slope.

These properties are evaluated, and the degree of *none* or *slight*, *moderate*, or *severe* limitation is indicated in table 8 for the following uses:

Camp dwellings.—Ratings apply to recreational building sites for seasonal and year-round cottages, wash-

rooms and bathhouses, picnic shelters, and other utility buildings.

Camp areas.—The ratings apply to areas that are to be used intensively for tents and small camp trailers and the accompanying activities for outdoor living. Ratings include consideration of the ability of the soils to support traffic-bearing vegetation.

Picnic areas.—Ratings apply to intensive use of areas for community or individual picnic areas.

Intensive play areas.—Evaluations apply to areas to be developed for playgrounds and organized games, such as baseball, football, badminton, and other similar games. Areas selected for this use are subject to intensive foot traffic; therefore, the ability of the soil to support a dense growth of traffic-bearing vegetation is important.

Paths and trails.—Ratings apply to areas that are to be used for trails, cross-country hiking, bridle paths, and nonintensive uses that allow for random movement of people. It is assumed that such areas will require a minimum of site preparation.

Golf fairways.—Ratings apply to use for the golf fairway area between greens. These areas are generally vegetated. Establishing and maintaining a vegetative cover are the chief concerns.

In selecting a site for a particular use, the soil limitation rating given a kind of soil, though important, is only one criterion to be considered. Location, land values, and esthetic values are other criteria. In some circumstances, a soil limitation can be modified or removed so the soil can be used for the intended purpose. For this reason, some kinds of soil rated as *severe* can be used for the intended use. This is especially important where good sites are scarce.

The detailed soil map in the back of this survey and the sections "Use and Management of the Soils" and "Engineering" will also be helpful in planning recreational facilities.

Formation and Classification of the Soils

This section describes the five major factors of soil formation and tells how these factors have affected the soils in Scotland County. It also defines the system of classification currently used in the National Cooperative Soil Survey and classifies the soils in the county according to that system.

Factors of Soil Formation

The five major factors of soil formation are (1) parent material, (2) climate, (3) living organisms, (4) topography, and (5) time. Parent material is the unconsolidated mass or soil material from which a soil forms. Living organisms include plants, animals, insects, bacteria, and fungi. Topography is the relief or lay of the land. The factors of soil formation are closely interrelated. For example, climate and living organisms, conditioned by relief and length of time, act on parent material to change it into a soil that contains genetically related horizons, or layers. The parent material determines to a great extent the physical and chemical com-

TABLE 8.—*Degree and kind of limitation*

Soil series and map symbols	Camp dwellings	Camp areas
Alvin: AIC.....	Slight.....	Slight.....
Arbela: Ar.....	Severe: flooding or ponding.....	Moderate: somewhat poorly drained.....
Armster:		
AsC2.....	Slight.....	Moderate: moderately well drained; moderately slow permeability.
AsD2.....	Moderate: slope.....	Moderate: slope; moderately well drained; moderately slow permeability.
Blackoar: Bk, Br..... For Arbela part of Br, see Arbela series.	Severe: flooding or ponding; poorly drained.	Severe: flooding or ponding; poorly drained.
Chariton: Ch.....	Severe: poorly drained.....	Severe: poorly drained.....
Chequest: Cm.....	Severe: flooding or ponding; poorly drained.	Severe: flooding or ponding; poorly drained.
Colo: Co.....	Severe: flooding or ponding; poorly drained.	Severe: flooding or ponding; poorly drained.
Edina: Ed.....	Severe: poorly drained.....	Severe: very slow permeability; poorly drained.
Fatima: Fa.....	Severe: flooding or ponding.....	Moderate: moderately well drained.....
Gara:		
GaD2.....	Moderate: slope.....	Moderate: moderately slow permeability; slope; moderately well drained.
GaE2.....	Severe: slope.....	Severe: slope.....
Gifford: GfB, GfC2.....	Moderate: somewhat poorly drained.....	Severe: very slow permeability; somewhat poorly drained.
Gorin: GoC2.....	Moderate: somewhat poorly drained.....	Moderate: somewhat poorly drained; slow permeability.
Kilwinning: KIB.....	Moderate: somewhat poorly drained.....	Severe: very slow permeability.....
Lamoni:		
LaC.....	Moderate: somewhat poorly drained.....	Severe: very slow permeability.....
LaD.....	Moderate: somewhat poorly drained.....	Severe: very slow permeability.....
Lindley:		
LdD2.....	Moderate: slope.....	Moderate: moderately slow permeability; slope.
LdE2.....	Severe: slope.....	Severe: slope.....
LdF2.....	Severe: slope.....	Severe: slope.....
Marion: Ma.....	Severe: poorly drained.....	Severe: very slow permeability; poorly drained.
Vigar: VgB.....	Slight.....	Moderate: moderately slow permeability.....
Wabash: Wa.....	Severe: flooding or ponding; very poorly drained.	Severe: very slow permeability; flooding or ponding; very poorly drained.
Westerville: We.....	Severe: flooding or ponding.....	Moderate: somewhat poorly drained.....

of soils for recreational use

Picnic areas	Playgrounds	Paths and trails	Golf fairways
Slight.....	Severe: slope.....	Slight.....	Slight.
Moderate: flooding or ponding; somewhat poorly drained.	Moderate: flooding or ponding.	Moderate: flooding or ponding; somewhat poorly drained.	Moderate: flooding or ponding; somewhat poorly drained.
Moderate: moderately well drained.	Severe: slope.....	Slight.....	Slight.
Moderate: slope; moderately well drained.	Severe: slope.....	Slight.....	Moderate: slope.
Severe: flooding or ponding; poorly drained.	Severe: flooding or ponding; poorly drained.	Severe: poorly drained.....	Severe: poorly drained.
Severe: poorly drained.....	Severe: poorly drained.....	Severe: poorly drained.....	Severe: poorly drained.
Severe: flooding or ponding; poorly drained.	Severe: flooding or ponding; poorly drained.	Severe: poorly drained.....	Severe: poorly drained.
Severe: flooding or ponding; poorly drained.	Severe: flooding or ponding; poorly drained.	Severe: poorly drained.....	Severe: poorly drained.
Severe: poorly drained.....	Severe: very slow permeability; poorly drained.	Severe: poorly drained.....	Severe: poorly drained.
Moderate: flooding or ponding; moderately well drained.	Severe: flooding or ponding....	Slight.....	Moderate: flooding or ponding.
Moderate: slope; moderately well drained.	Severe: slope.....	Slight.....	Moderate: slope.
Severe: slope.....	Severe: slope.....	Moderate: slope.....	Moderate: slope.
Moderate: somewhat poorly drained.	Severe: very slow permeability; somewhat poorly drained.	Moderate: somewhat poorly drained.	Slight.
Moderate: somewhat poorly drained.	Severe: slope.....	Moderate: somewhat poorly drained.	Slight.
Moderate: somewhat poorly drained.	Severe: very slow permeability.	Moderate: somewhat poorly drained.	Slight.
Moderate: somewhat poorly drained.	Severe: very slow permeability.	Moderate: somewhat poorly drained.	Slight.
Moderate: slope; somewhat poorly drained.	Severe: very slow permeability; slope.	Moderate: somewhat poorly drained.	Moderate: slope.
Moderate: slope.....	Severe: slope.....	Slight.....	Moderate: slope.
Severe: slope.....	Severe: slope.....	Moderate: slope.....	Moderate: slope.
Severe: slope.....	Severe: slope.....	Severe: slope.....	Severe: slope.
Severe: poorly drained.....	Severe: poorly drained.....	Severe: poorly drained.....	Severe: poorly drained.
Slight.....	Moderate: moderately slow permeability; slope.	Slight.....	Slight.
Severe: flooding or ponding; very poorly drained.	Severe: flooding or ponding; very slow permeability; very poorly drained.	Severe: very poorly drained....	Severe: very poorly drained.
Moderate: flooding or ponding; somewhat poorly drained.	Severe: flooding or ponding....	Moderate: flooding or ponding; somewhat poorly drained.	Moderate: flooding or ponding.

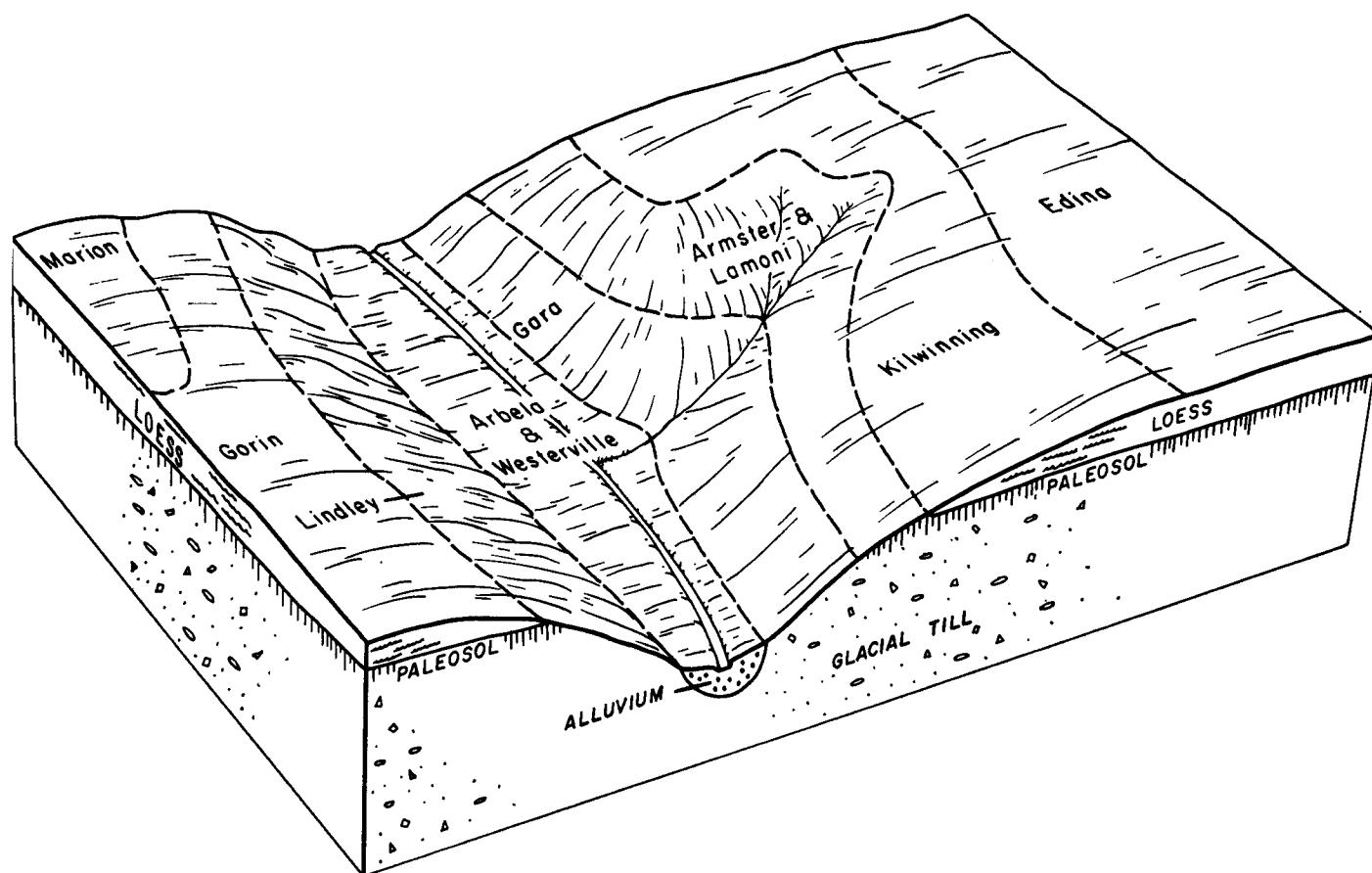


Figure 5.—Typical distribution of some major upland and bottom land soils in relation to slope and parent material.

position of a soil, but the composition is also influenced by climate, relief, living organisms, and length of time.

The relationship of some upland and bottom land soils to their respective topographical positions and parent materials is shown in figure 5.

Parent material

Parent material is the unconsolidated mass from which a soil forms. It determines, to a great extent, the mineralogical composition of the soil. Two distinct kinds of parent material are typical in Scotland County: glacial till, which is material transported by a glacier, and loess, material transported by wind.

Scotland County was completely covered by the Kansan Glacier many thousands of years ago. The remaining glacial till in the county ranges from about 20 to nearly 200 feet thick. It was originally calcareous, but has now been leached to varying depths, generally 3 feet or more. Soils formed entirely from this material include the Armster, Gara, and Lindley soils.

Several thousands of years after the glacier, loess was transported from the mudflats of the Missouri River and its larger tributaries. These mudflats were created by heavy flooding from distant melting glaciers. Most of the loess remaining in Scotland County ranges from 5 to 10 feet thick. Soils that formed entirely in loess include the Edina, Kilwinning, and Marion soils.

Some of the soils of Scotland County formed in allu-

vium, which is material deposited by some streams, and some in colluvium, which is soil material at the base of steep slopes. Some formed in a mixture of both. The Vigar soils formed entirely in colluvium. On bottoms adjacent to the stream channels coarse-textured materials are deposited by rapidly flowing water. The Alvin soils formed in this kind of material. Fine-textured materials are deposited in the broader, more level areas away from the stream channels, and the finest textured material is deposited by the slowest moving water. Arbela, Blackoar, Chequest, Colo, Fatima, Wabash, and Westerville soils formed in these fine-textured materials.

Climate

Scotland County frequently has varying temperature changes over short periods of time. Both in summer and in winter, the temperature can vary as much as 50 degrees in the space of a few hours, as cold or warm fronts move across the area. The average annual precipitation is 37 inches. About two-thirds of it falls in the period April through September. In this county the effect of climate on soil formation would be about average for a temperate, moderately humid climate.

The balance between temperature and precipitation in this area has a favorable influence on soil formation and contributes to a desirable growing season. Where rainfall is greater, the upland soils are more leached and less fertile. Where rainfall is less, the soils are more fertile

but the amount of available moisture is too low for favorable growing conditions.

Because the climate is fairly uniform throughout the county, it has caused no major differences among the soils.

Living organisms

Plants, animals, insects, bacteria, and fungi affect the formation of soils. Most noticeable in Scotland County are the contrasting soils formed under two main types of vegetation: prairie grasses and trees. Soils formed under prairie grasses have a darker, thicker surface layer than soils formed under deciduous trees because the large amount of dense, fine roots decays rapidly and adds a large amount of organic matter to the surface layer. Bacterial activity is high. Soils that formed under grass make up about 65 percent of Scotland County. The Armster, Edina, Gara, Kilwinning, and Lamoni are examples of such soils.

Soils formed under deciduous trees have a lighter colored subsurface layer, are more acid, and have a very thin, dark-colored surface layer. As leaves decompose, solvent acids leach out the surface layer and the subsoil. There is more fungus and less bacteria and earthworm activity. The Gorin, Lindley, and Marion soils formed under deciduous trees. They are adjacent to streams and on ridgetops.

Relief

Relief affects soil formation through its influence on runoff, erosion, plant cover, and soil temperature. Slow or very slow runoff in the nearly level areas of the uplands contributed to the formation of the Edina soils, which have slow internal drainage, a leached, light-gray subsurface horizon, and a dense claypan. These soils formed under grass.

Rapid runoff on steep slopes causes erosion. Even under native vegetation, the soils erode to some degree during formation. The steep Lindley soils formed under deciduous trees in these better drained areas. In areas where the vegetation is a mixture of grass and deciduous trees, Armster soils formed.

Both the gradient and the direction of slope influence the temperature of the soil. The soils that have south-facing slopes thaw out and warm up earlier in spring and cool more quickly in fall. These conditions are reversed on north-facing slopes. The steeper, better drained soils also warm up earlier in spring.

Time

Time, usually a long time, is required for the formation of soils that have distinct horizons. The difference in length of time that parent material has been in place, therefore, is commonly reflected in the degree of development of the soil profile.

The older soils in Scotland County are on uplands, where they formed in glacial till and loess, or a combination of the two. The Edina and Lindley are examples of older soils. This parent material has been in place thousands of years, and the soils on uplands have well-defined horizons. The weathering process has moved the finer particles downward, where they accumulated in the subsoil, making it more clayey than the surface layer. In addition, some of the minerals and humus have been

leached from the surface layer and have made the subsurface layer light colored, as in Marion soils, for example.

The young soils are forming near streams, where over-flow deposits new material from time to time. The Fatima soil is an example of a young soil.

Classification of the Soils

The purpose of soil classification is to help us remember the significant characteristics of soils, assemble our knowledge about the soils, see their relationships to one another and to the whole environment, and develop principles relating to their behavior and their response to manipulation. First through classification and then through the use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The current system of soil classification (7, 9) was adopted by the Cooperative Soil Survey in 1965. It is a comprehensive system, designed to accommodate all soils. In this system classes of soils are defined in terms of observable or measurable properties. The properties chosen are primarily those that result in the grouping of soils of similar genesis, or mode of origin. Genesis does not, however, appear in the definitions of the classes.

The current system of classification has six categories. Beginning with the most inclusive, the categories are the order, the suborder, the great group, the subgroup, the family, and the series. Table 9 shows the classification of the soils of Scotland County according to this system. Brief descriptions of the six categories follow.

ORDER: Ten soil orders are recognized: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate orders are those that tend to give broad climatic groupings of soils. Two exceptions of this generalization are the Entisols and the Histosols, both of which occur in many different climates. Three of the ten orders are represented in Scotland County: Alfisols, Entisols, and Mollisols.

SUBORDER: Each order is divided into suborders, mainly on the basis of soil characteristics that result in grouping soils according to genetic similarity. The climatic range is narrower than that of the order. The properties used are mainly those that reflect either the presence or absence of waterlogging or differences in climate or vegetation.

GREAT GROUP: Each suborder is divided into great groups on the basis of similarity in the kind and sequence of the major horizons and in major soil properties. The horizons considered are those in which clay, iron, or humus have accumulated and those in which pans that interfere with the growth of roots and the movement of water have formed. The properties are soil temperature, chemical composition (mainly content of calcium, magnesium, sodium, and potassium), and the like.

SUBGROUP: Each great group is divided into subgroups, one that represents the central (typic) concept of the group, and others, called intergrades, that have one or more properties of another great group, suborder, or order.

TABLE 9.—*Soil series classified according to the current system*

[Classification current as of May 1973]

Series	Family	Subgroup	Order
Alvin ¹	Coarse-loamy, mixed, mesic.....	Typic Halpudalfs.....	Alfisols.
Arbela.....	Fine, montmorillonitic, mesic.....	Argiaquic Argialbolls.....	Mollisols.
Armster.....	Fine, montmorillonitic, mesic.....	Mollic Hapludalfs.....	Alfisols.
Blackoar.....	Fine-silty, mixed, mesic.....	Fluvaquentic Haplaquolls.....	Mollisols.
Chariton.....	Fine, montmorillonitic, mesic.....	Mollic Albaqualfs.....	Alfisols.
Chequest.....	Fine, montmorillonitic, mesic.....	Typic Haplaquolls.....	Mollisols.
Colo.....	Fine-silty, mixed, mesic.....	Cumulic Haplaquolls.....	Mollisols.
Edina.....	Fine, montmorillonitic, mesic.....	Typic Argialbolls.....	Mollisols.
Fatima.....	Fine-silty, mixed, mesic.....	Fluvaquentic Hapludolls.....	Mollisols.
Gara ²	Fine-loamy, mixed, mesic.....	Mollic Hapludalfs.....	Alfisols.
Gifford.....	Fine, montmorillonitic, mesic.....	Vertic Ochraqualfs.....	Alfisols.
Gorin.....	Fine, montmorillonitic, mesic.....	Aquic Hapludalfs.....	Alfisols.
Kilwinning.....	Fine, montmorillonitic, mesic.....	Vertic Ochraqualfs.....	Alfisols.
Lamoni.....	Fine, montmorillonitic, mesic.....	Aquic Argiudolls.....	Mollisols.
Lindley.....	Fine-loamy, mixed, mesic.....	Typic Hapludalfs.....	Alfisols.
Marion.....	Fine, montmorillonitic, mesic.....	Albaquic Hapludalfs.....	Alfisols.
Vigar.....	Fine-loamy, mixed, mesic.....	Aquic Argiudolls.....	Mollisols.
Wabash.....	Fine, montmorillonitic, mesic.....	Vertic Haplaquolls.....	Mollisols.
Westerville.....	Fine-silty, mixed, acid, mesic.....	Aeric Fluvaquents.....	Entisols.

¹ The Alvin soils in Scotland County are taxadjuncts to the Alvin series. They have a thinner solum, have a slightly lower clay content in the B horizon, and are slightly coarser textured than is described as the range defined for the series.

² The Gara soils in Scotland County are taxadjuncts to the Gara series. They have slightly more clay, by weighted average, in the upper 20 inches of the argillic horizon than is described as the range defined for the series.

FAMILY: Families are established within each subgroup, primarily on the basis of properties important to the growth of plants or properties significant in engineering. Texture, mineral composition, reaction, soil temperature, are among the properties considered.

SERIES: A series is a group of soils that have horizons similar in all important characteristics, except for texture of the surface layer, and similar in arrangement in the profile.

Additional Facts About the County

Scotland County was a part of the territory acquired in the Louisiana Purchase of 1803. Scotland County and the northern part of Knox County were originally included in Lewis County. In 1841 Scotland County was organized. It included all of what is now Scotland and Knox Counties. The present boundaries were established in 1843, and Memphis was chosen as the county seat.

Settlers, mostly from Kentucky, Pennsylvania, and Virginia, began arriving in 1832. They first settled in the southern part of the county in the vicinities of Sand Hill, Bible Grove, and Pleasant Retreat.

Originally, nearly all of the county was covered with natural prairie grasses, and the trees grew mostly along and adjacent to the streams and small drainageways. The nearly level areas of soils, on the three major divides, are no more than a mile wide in most places, but are among the most valuable acreages for farming. The rest of the soils in the county range from gently sloping to steep.

All major streams, including the Fox, North and South Wyaconda, and North and South Fabius Rivers, flow in a southeasterly direction. The stream valleys, most of which are deep and wide for the size of the stream,

make up a large acreage of productive bottom-land soils. Almost all of the North Fabius channel has been straightened. The water supply comes from rivers, small ponds and cisterns, and a few shallow wells.

Electrical and telephone service is available to nearly all rural areas. Most roads in the county are now graveled or hard surfaced. The county is served by two major railroads. Memphis is served by a major freight truck-line.

Land in the 1,300 farms totals about 271,586 acres. The average size of farms is steadily increasing because many owners purchase smaller farms and add to their own to make a larger, more economical farming unit.

Corn, soybeans, and wheat are the main cultivated and cash crops. The wheat and soybeans are sold mainly as cash crops.

Climate⁴

Scotland County has a typical continental climate, which is characterized by frequent changes in temperature, humidity, cloudiness, and winds. Prolonged warm spells in summer are infrequent. Major droughts seldom occur, but extended periods of dry weather late in the growing season are not unusual.

The temperature and precipitation data given in table 10 are from the National Weather Service's cooperative station at Memphis, near the center of the county.

Scotland County is just south of the usual path of the cold Arctic air masses that invade the north-central United States each winter. Subzero temperatures occur on the average of 12 times a year. Frequent occurrences of raw, blustery days with strong northerly winds and cold temperatures make outdoor work difficult during

⁴ Prepared by WARREN M. WISNER, climatologist for Missouri.

TABLE 10.—*Temperature and precipitation data*

[Data from records kept at Memphis]

Month	Temperature							Precipitation					
	Average daily			Two years in 10 will have at least 4 days with—		Extremes		Average	One year in 10 will have—		Great-est daily rainfall	Snowfall	
	Maxi-mum	Mini-mum	Aver-age	Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—	Maxi-mum	Mini-mum		Less than—	More than—		Average	Maxi-mum
	°F.	°F.	°F.	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Inches	Inches	Inches
January	33. 8	12. 7	23. 3	55	— 7	70	— 20	1. 64	0. 28	4. 34	2. 93	6. 7	18. 0
February	39. 2	17. 4	28. 3	62	— 1	71	— 18	1. 12	. 36	1. 87	1. 21	5. 3	13. 0
March	48. 7	25. 9	37. 3	71	10	83	— 13	2. 51	. 31	5. 43	1. 90	4. 4	15. 5
April	63. 0	38. 9	51. 0	80	26	91	0	3. 58	1. 35	7. 06	3. 19	1. 0	8. 0
May	75. 1	50. 2	62. 7	89	47	95	26	3. 12	1. 54	5. 23	3. 10	(¹)	0
June	83. 3	59. 7	71. 5	93	48	102	39	4. 08	1. 26	6. 11	3. 35	0	0
July	88. 2	64. 0	76. 1	99	53	106	44	4. 00	1. 83	7. 14	3. 65	0	0
August	86. 0	60. 8	73. 4	95	50	102	41	4. 32	. 90	6. 62	4. 20	0	0
September	78. 9	51. 9	65. 4	92	40	102	29	3. 59	. 58	10. 14	4. 54	0	0
October	69. 5	42. 5	56. 0	85	27	98	15	2. 93	. 28	6. 04	2. 75	. 1	3. 0
November	52. 2	29. 2	40. 7	72	14	88	— 13	1. 43	0	3. 71	1. 88	1. 2	8. 0
December	37. 9	18. 0	28. 0	59	— 2	70	— 23	1. 43	. 05	2. 92	1. 29	5. 4	13. 5
Annual	63. 1	39. 4	51. 2	-----	-----	106	— 23	33. 75	23. 80	40. 05	4. 54	24. 1	-----

¹ Less than 0.05 inch.

the winter. In summer the temperature reaches 100° in only 4 out of every 10 years, and then it seldom lasts for more than a day or two.

The average length of the growing season is about 172 days. Nighttime temperatures in valleys and depressions are usually colder than those reported at other locations on level ground or along ridges during periods of light wind when radiation freezes often occur. Table 11 shows the last date in spring and the first date in fall when specified freezing temperatures can be expected. The data in this table are based on instrument readings taken 5 feet above ground level. Frost can occur at ground level when the temperature at the observation level is above freezing.

Precipitation averages slightly less than 34 inches a year and is distributed evenly through the growing

season. Most of the rain falls during thundershowers. It is not unusual to have 2 or more inches fall during one shower. Monthly extremes have ranged from 0 inches in November 1955 and 1969 to 21.96 inches in August 1970.

Snowfall averages about 24 inches a year. The heaviest snowfall is usually in January. Snowfall data are included in table 10.

Violent storms are often typical in spring when the warm, humid air masses from the Gulf of Mexico clash with the cooler continental air masses. Since 1916, only four tornadoes have been reported in Scotland County. Hailstorms are infrequent and ordinarily occur early in summer when they are potentially the least damaging to field crops.

TABLE 11.—*Probability of freezing temperatures in spring and fall*

Probability	Date of occurrence for given probability and temperature				
	32° F.	28° F.	24° F.	20° F.	16° F.
Spring:					
1 year in 10 later than.....	May 1	April 23	April 11	April 5	March 25
2 years in 10 later than.....	April 30	April 22	April 10	April 4	March 23
5 years in 10 later than.....	April 27	April 19	April 7	March 31	March 20
Fall:					
1 year in 10 earlier than.....	October 1	October 16	October 21	November 1	November 6
2 years in 10 earlier than.....	October 3	October 18	October 24	November 4	November 9
5 years in 10 earlier than.....	October 7	October 22	October 27	November 8	November 13

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Glossary

- Alluvium.** Soil material, such as sand, silt, or clay, that has been deposited on land by streams.
- Association, soil.** A group of soils geographically associated in a characteristic repeating pattern.
- Available water capacity** (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.
- Bench terrace.** A shelflike embankment of earth that has a level or nearly level top and a steep or nearly vertical downhill face, constructed along the contour of sloping land or across the slope to control runoff and erosion. The downhill face of the bench may be made of rocks or masonry, or it may be planted to vegetation.
- Calcareous soil.** A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.
- Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Organic matter. A general term for plant and animal material, in or on the soil in all stages of decomposition. Readily decomposed organic matter is often distinguished from the more stable forms that are past the stage of rapid decomposition.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid.*

pH value. A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Productivity (of soil). The present capability of a soil for producing a specified plant or sequence of plants under a specified system of management. It is measured in terms of output, or harvest, in relation to input of production for the specific kind of soil under a specified system of management.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

pH		pH	
Extremely acid----	Below 4.5	Neutral -----	6.6 to 7.3
Very strongly acid--	4.5 to 5.0	Mildly alkaline-----	7.4 to 7.8
Strongly acid-----	5.1 to 5.5	Moderately alkaline--	7.9 to 8.4
Medium acid-----	5.6 to 6.0	Strongly alkaline-----	8.5 to 9.0
Slightly acid-----	6.1 to 6.5	Very strongly alkaline -----	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Shrink-swell potential (engineering). Amount that a soil will expand when wet or contract when dry. Indicates kinds of clay in soil.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slope class. The slope classes recognized in this survey are as follows:

	Percent
Nearly level-----	0 to 2
Gently sloping-----	2 to 5
Moderately sloping-----	5 to 9
Strongly sloping-----	9 to 14
Moderately steep-----	14 to 20
Steep -----	20 to 30

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stone line. A concentration of coarse rock fragments in soils that generally represents an old weathering surface. In a cross section, the line may be one stone or more thick. The line generally overlies material that weathered in place, and it is ordinarily overlain by sediment of variable thickness.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

GUIDE TO MAPPING UNITS

For complete information about a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. Other information is given in tables, as follows:

Acres and extent, table 1, page 4.
Estimated yields, table 2, page 21.
Woodland, table 4, pages 24-25.

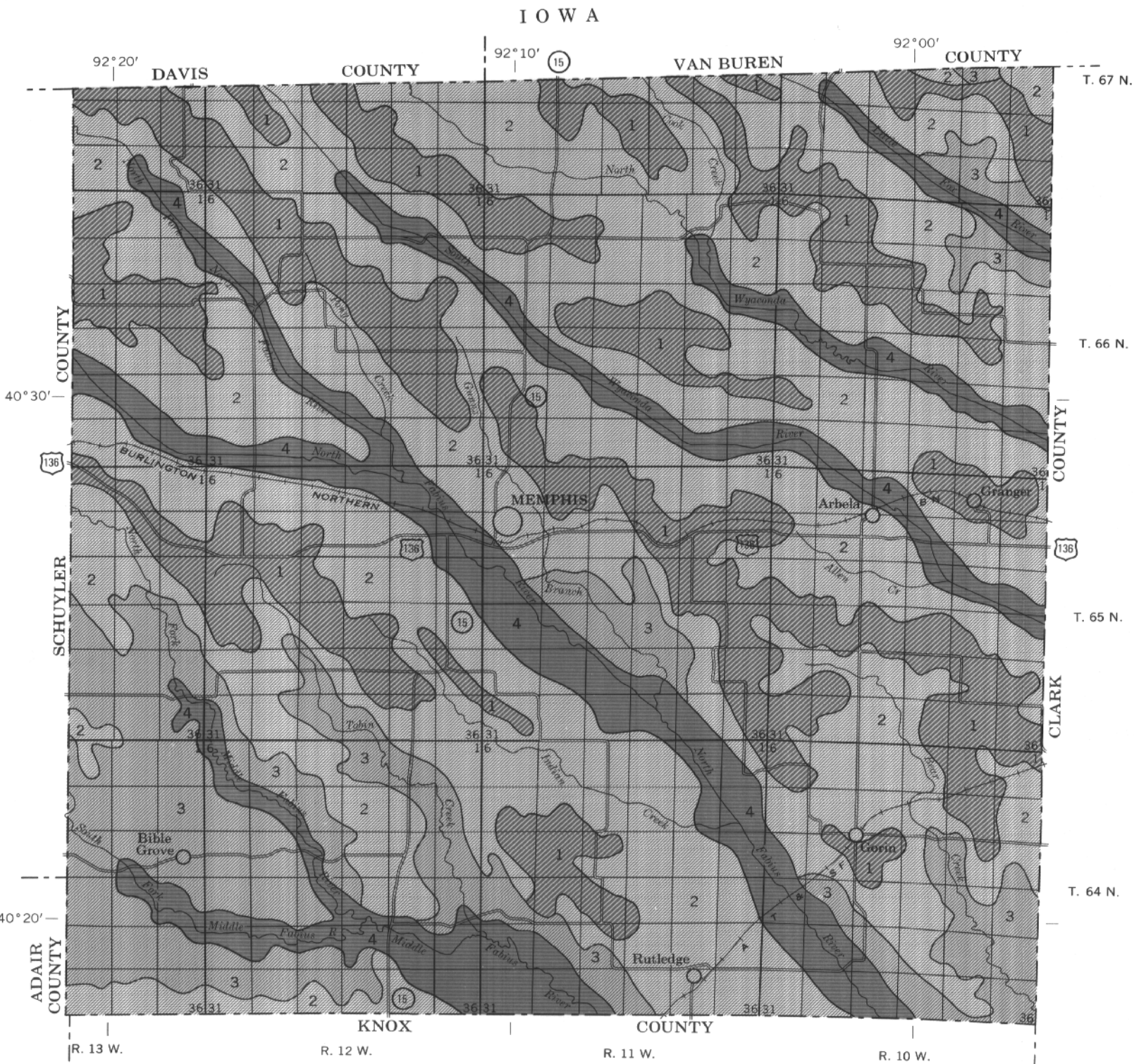
Engineering, tables 5, 6, and 7, pages 26 to 35.
Recreation, table 8, pages 38-39.

Map symbol	Mapping unit	Described on page	Capability unit	
			Symbol	Page
AlC	Alvin fine sandy loam, 5 to 9 percent slopes-----	4	IVe-7	19
Ar	Arbela silt loam-----	5	IIw-1	17
AsC2	Armster loam, 5 to 9 percent slopes, eroded-----	5	IIIe-5	17
AsD2	Armster loam, 9 to 14 percent slopes, eroded-----	5	IVe-5	19
Bk	Blackoar silt loam-----	6	IIw-1	17
Br	Blackoar-Arbela silt loams-----	6	IIw-1	17
Ch	Chariton silt loam-----	7	IIw-2	17
Cm	Chequest silty clay loam-----	7	IIw-1	17
Co	Colo silty clay loam-----	7	IIw-1	17
Ed	Edina silt loam-----	8	IIw-2	17
Fa	Fatima silt loam-----	9	I-1	17
GaD2	Gara loam, 9 to 14 percent slopes, eroded-----	10	IVe-1	18
GaE2	Gara loam, 14 to 20 percent slopes, eroded-----	10	VIe-1	20
GfB	Gifford silt loam, 2 to 5 percent slopes-----	11	IIe-5	17
GfC2	Gifford silt loam, 5 to 9 percent slopes, eroded-----	11	IIIe-5	17
GoC2	Gorin silt loam, 5 to 9 percent slopes, eroded-----	11	IIIe-5	17
KlB	Kilwinning silt loam, 2 to 5 percent slopes-----	12	IIe-5	17
LaC	Lamoni silt loam, 5 to 9 percent slopes-----	13	IIIe-5	17
LaD	Lamoni silt loam, 9 to 14 percent slopes-----	13	IVe-5	19
LdD2	Lindley loam, 9 to 14 percent slopes, eroded-----	13	IVe-4	19
LdE2	Lindley loam, 14 to 20 percent slopes, eroded-----	13	VIe-4	20
LdF2	Lindley loam, 20 to 30 percent slopes, eroded-----	14	VIIe-4	20
Ma	Marion silt loam-----	14	IIIw-2	18
VgB	Vigar loam, 2 to 5 percent slopes-----	15	IIe-2	17
Wa	Wabash silty clay-----	15	IIIw-14	18
We	Westerville silt loam-----	16	IIw-1	17

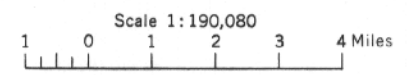
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U. S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE
 MISSOURI AGRICULTURAL EXPERIMENT STATION
GENERAL SOIL MAP
 SCOTLAND COUNTY, MISSOURI



SOIL ASSOCIATIONS

- 1** Kilwinning-Edina association: Deep, somewhat poorly drained and poorly drained soils that have a medium-textured surface layer and a very slowly permeable subsoil
- 2** Armster-Lamoni association: Deep, moderately well drained and somewhat poorly drained soils that have a medium-textured surface layer and a moderately slowly permeable or very slowly permeable subsoil
- 3** Gara-Lindley association: Deep, moderately well drained soils that have a medium-textured surface layer and a moderately slowly permeable subsoil
- 4** Arbela-Blackoak-Westerville association: Deep, poorly drained and somewhat poorly drained soils that have a medium-textured surface layer and a moderately permeable and moderately slowly permeable subsoil

Compiled 1973

Index Map

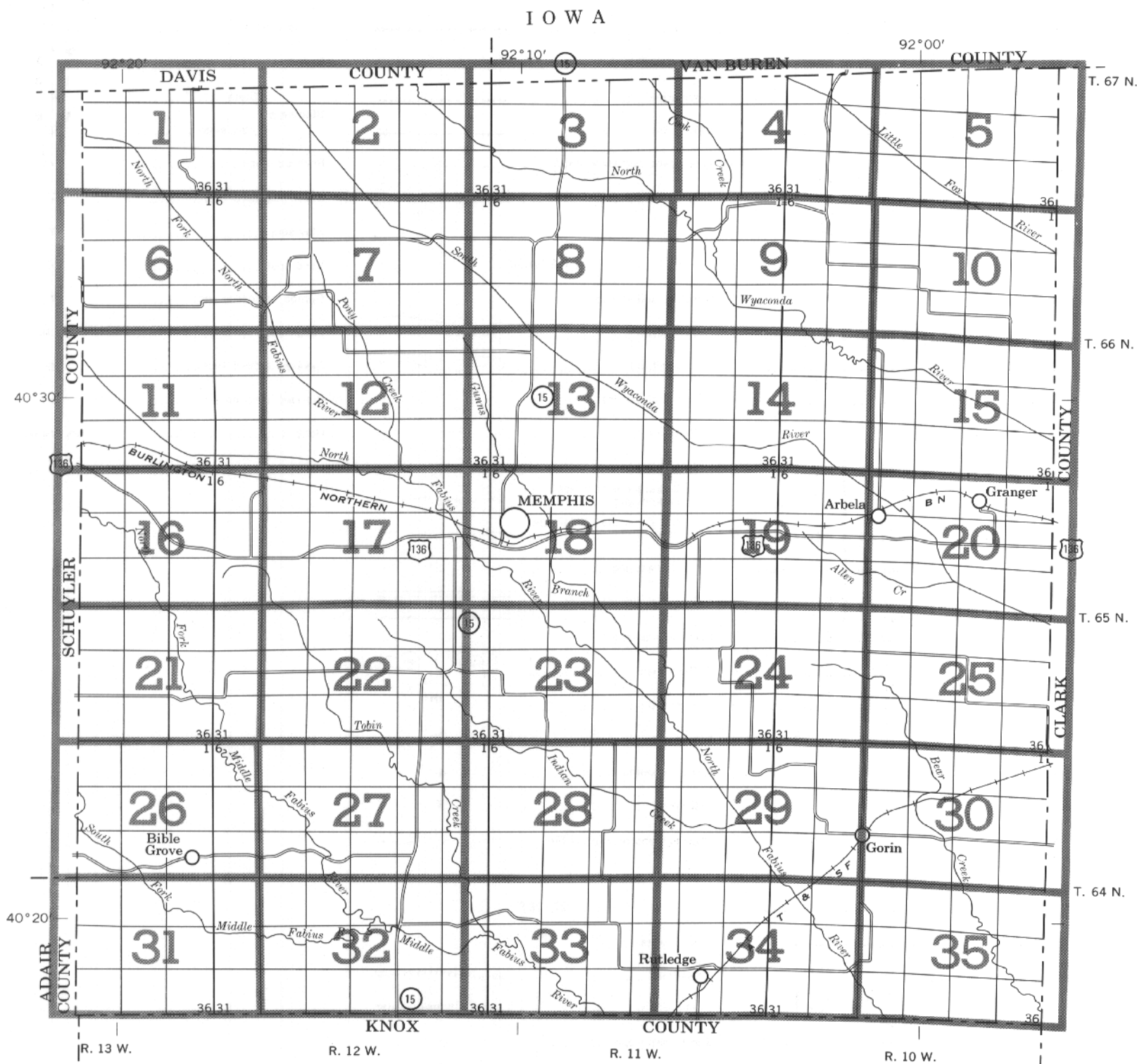
Welcome Page

Manuscript

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS SCOTLAND COUNTY, MISSOURI

Scale 1:190,080
1 0 1 2 3 4 Miles



General Soil Map

Welcome Page

Manuscript

SECTIONALIZED TOWNSHIP					
6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, B, C, D, E, or F, shows the slope. Symbols without a slope letter are those of nearly level soils. A final number, 2, in the symbol shows that the soil is eroded.

SYMBOL	NAME
A1C	Alvin fine sandy loam, 5 to 9 percent slopes
Ar	Arbela silt loam
AsC2	Armster loam, 5 to 9 percent slopes, eroded
AsD2	Armster loam, 9 to 14 percent slopes, eroded
Bk	Blackoak silt loam
Br	Blackoak-Arbela silt loams
Ch	Chariton silt loam
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GaE2	Gara loam, 14 to 20 percent slopes, eroded
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GFC2	Gifford silt loam, 5 to 9 percent slopes, eroded
GoC2	Gorin silt loam, 5 to 9 percent slopes, eroded
K1B	Kilwinning silt loam, 2 to 5 percent slopes
LaC	Lamoni silt loam, 5 to 9 percent slopes
LaD	Lamoni silt loam, 9 to 14 percent slopes
LdD2	Lindley loam, 9 to 14 percent slopes, eroded
LdE2	Lindley loam, 14 to 20 percent slopes, eroded
LdF2	Lindley loam, 20 to 30 percent slopes, eroded
Ma	Marion silt loam
VgB	Viglar loam, 2 to 5 percent slopes
Wa	Wabash silty clay
We	Westerville silt loam

WORKS AND STRUCTURES

Highways and roads	
Divided	
Good motor	
Poor motor	
Trail	
Highway markers	
National Interstate	
U. S.	
State or county	
Railroads	
Single track	
Multiple track	
Abandoned	
Bridges and crossings	
Road	
Trail	
Railroad	
Ferry	
Ford	
Grade	
R. R. over	
R. R. under	
Buildings	
School	
Church	
Mine and quarry	
Gravel pit	
Power line	
Pipeline	
Cemetery	
Dams	
Levee	
Tanks	
Well, oil or gas	
Forest fire or lookout station	
Windmill	
Located object	

CONVENTIONAL SIGNS

BOUNDARIES	
National or state	
County	
Minor civil division	
Reservation	
Land grant	
Small park, cemetery, airport	
Land survey division corners	
DRAINAGE	
Streams, double-line	
Perennial	
Intermittent	
Streams, single-line	
Perennial	
Intermittent	
Crossable with tillage implements	
Not crossable with tillage implements	
Unclassified	
Canals and ditches	
Lakes and ponds	
Perennial	
Intermittent	
Spring	
Marsh or swamp	
Wet spot	
Drainage end or alluvial fan	

RELIEF

Escarpments	
Bedrock	
Other	
Short steep slope	
Prominent peak	
Depressions	
Crossable with tillage implements	
Not crossable with tillage implements	
Contains water most of the time	

SOIL SURVEY DATA

Soil boundary and symbol	
Gravel	
Stoniness	
Stony	
Very stony	
Rock outcrops	
Chert fragments	
Clay spot	
Sand spot	
Gumbo or scabby spot	
Made land	
Severely eroded spot	
Blowout, wind erosion	
Gully	

Index Map

Welcome Page

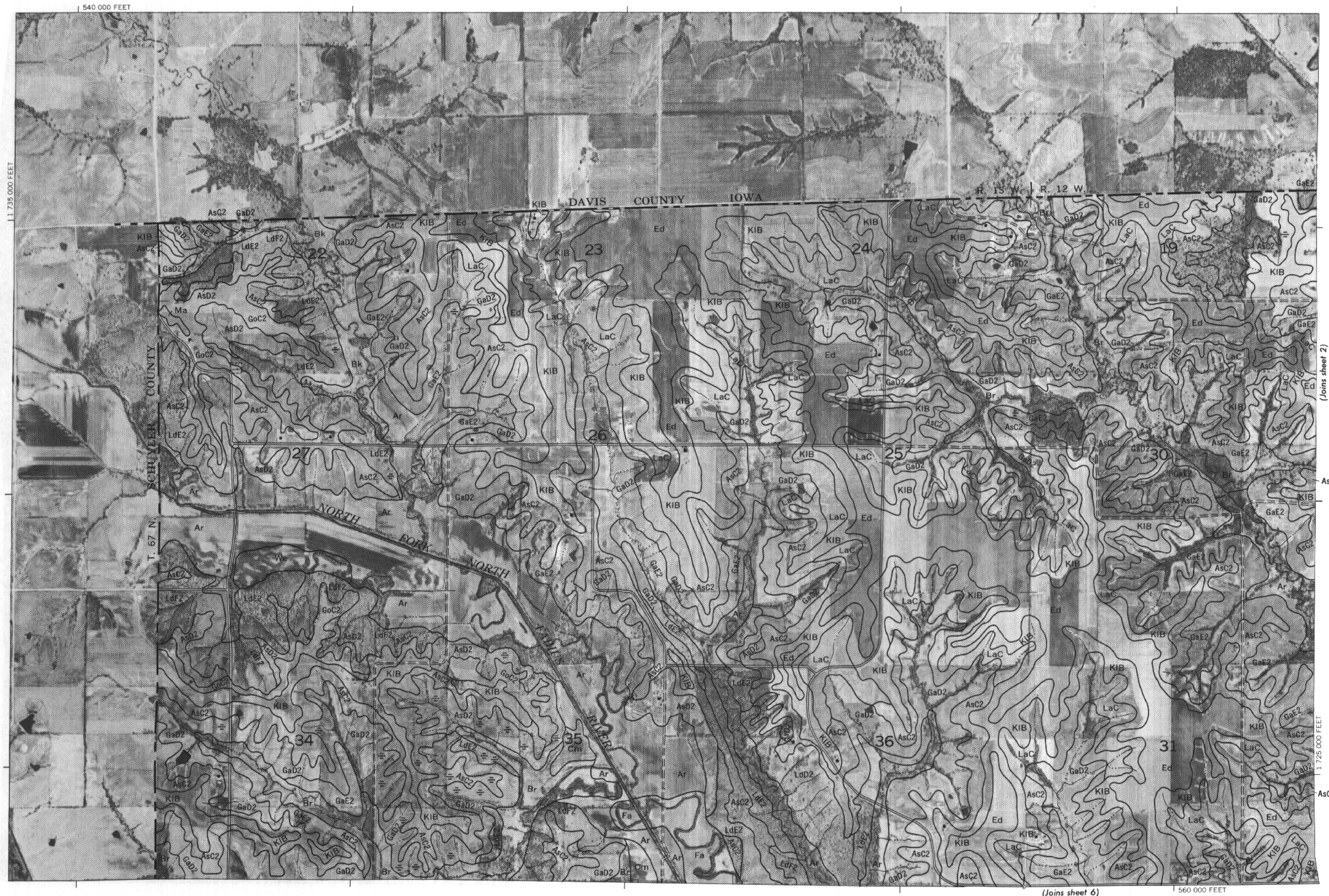
Manuscript



SCOTLAND COUNTY, MISSOURI — SHEET NUMBER 1

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station. Photobase from 1972 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, central zone. Land division corners are approximately positioned on this map.

SCOTLAND COUNTY, MISSOURI NO. 1



Scale 1:20,000

1 725 000 FEET

SCOTLAND COUNTY, MISSOURI — SHEET NUMBER 2

2



1 Mile
5000 Feet

0

1000

2000

3000

4000

5000

Scale 1:20000



585 000 FEET

1 735 000 FEET

T. 67 N.

(Joins sheet 3)

1 725 000 FEET

(Joins sheet 7)

GaE2

SCOTLAND COUNTY, MISSOURI NO. 2

Photobase from 1972 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, central zone. This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.





SCOTLAND COUNTY, MISSOURI NO. 4

Land division corners are approximately positioned on this map.

Photobase from 1972 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, central zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.



(Joins sheet 4) | T. 67 N.

(Joins sheet 10)

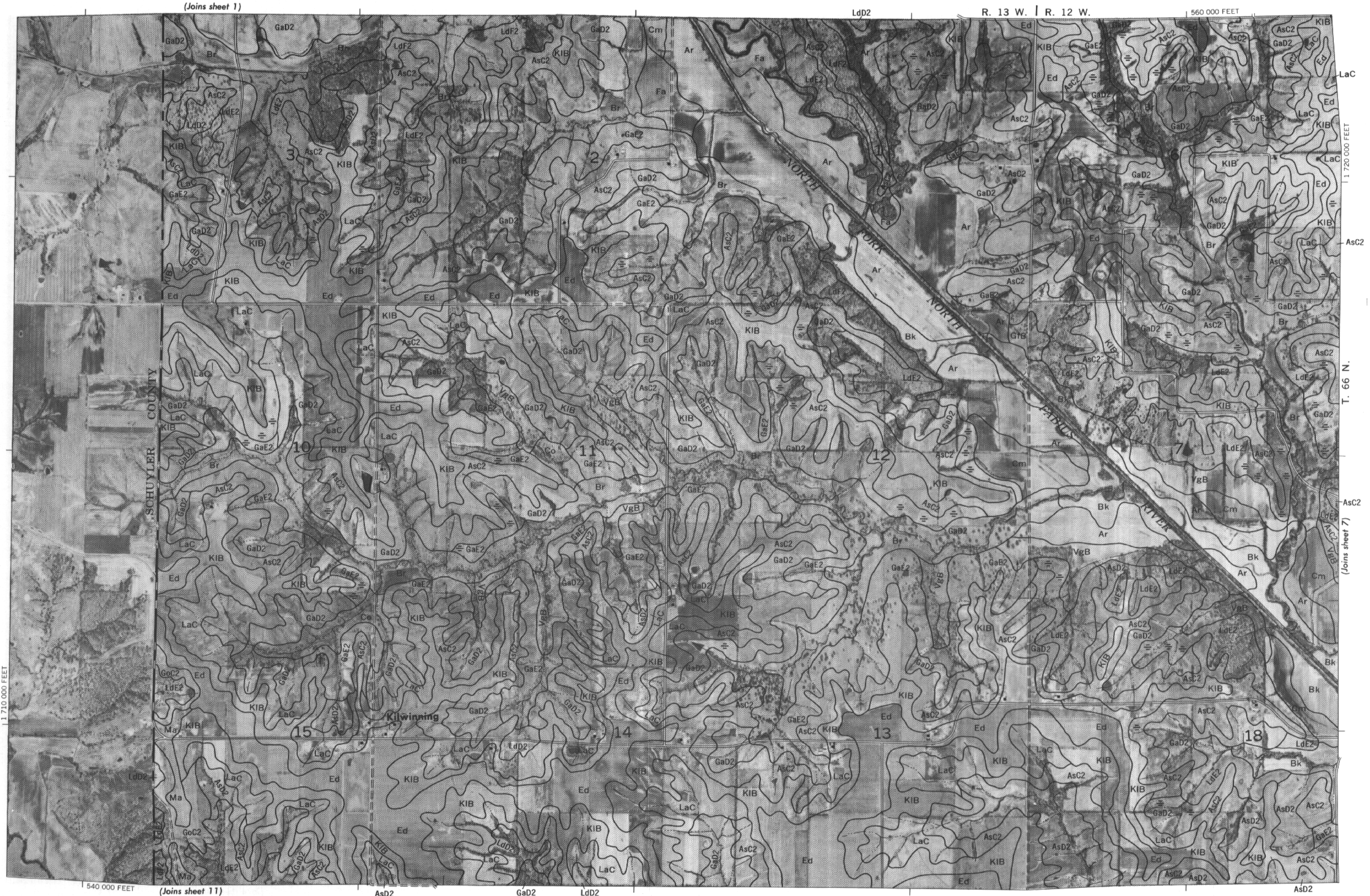
655 000 FEET

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station, as part of the National Cooperative Soil Survey. The map is based on 1972 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, central zone. Land division corners are approximately positioned on this map.

Land division corners are approximately positioned on this map.

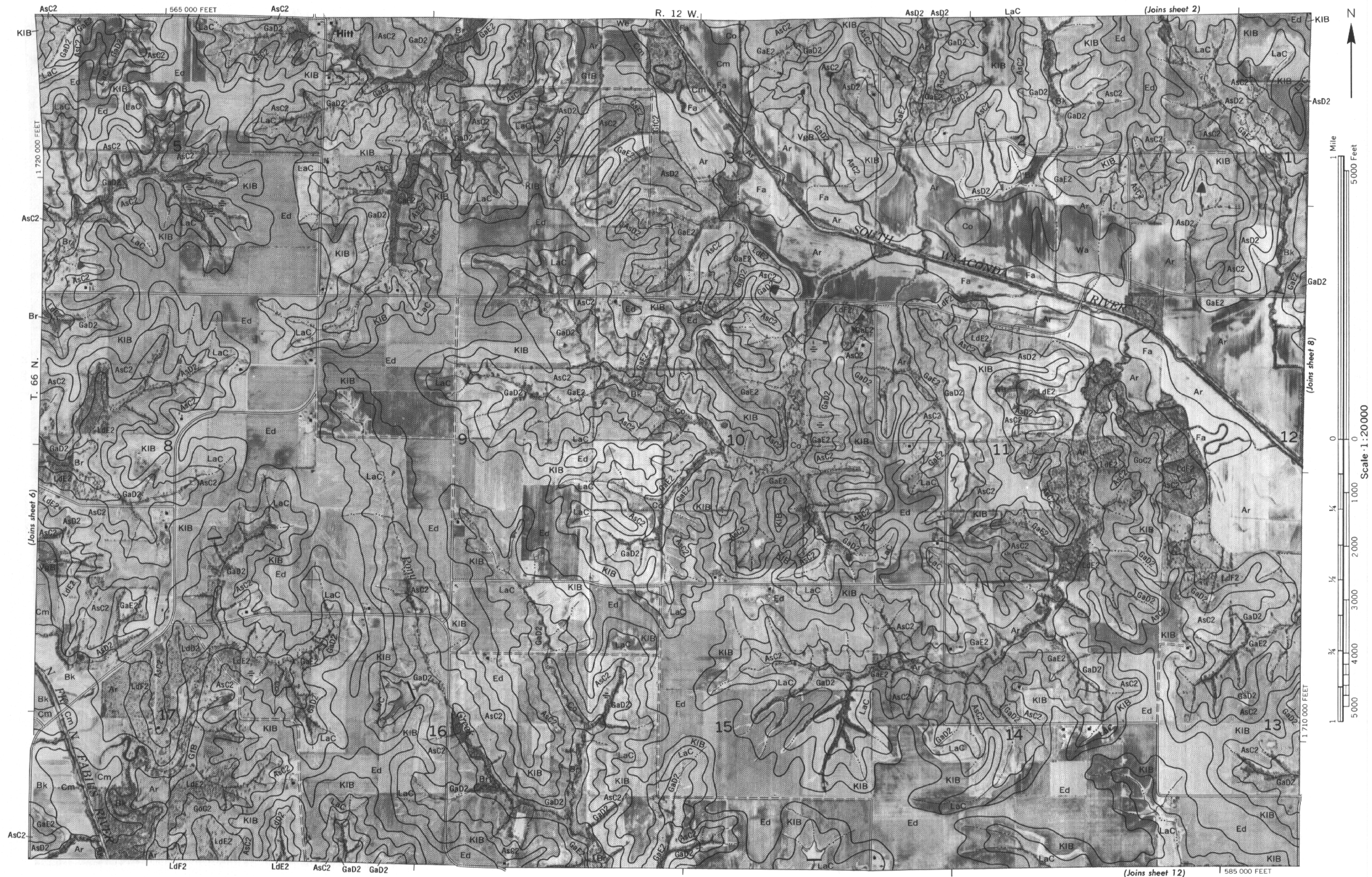
Photobase from 1972 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, central zone.

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SCOTLAND COUNTY, MISSOURI NO. 7



SCOTLAND COUNTY, MISSOURI — SHEET NUMBER 8

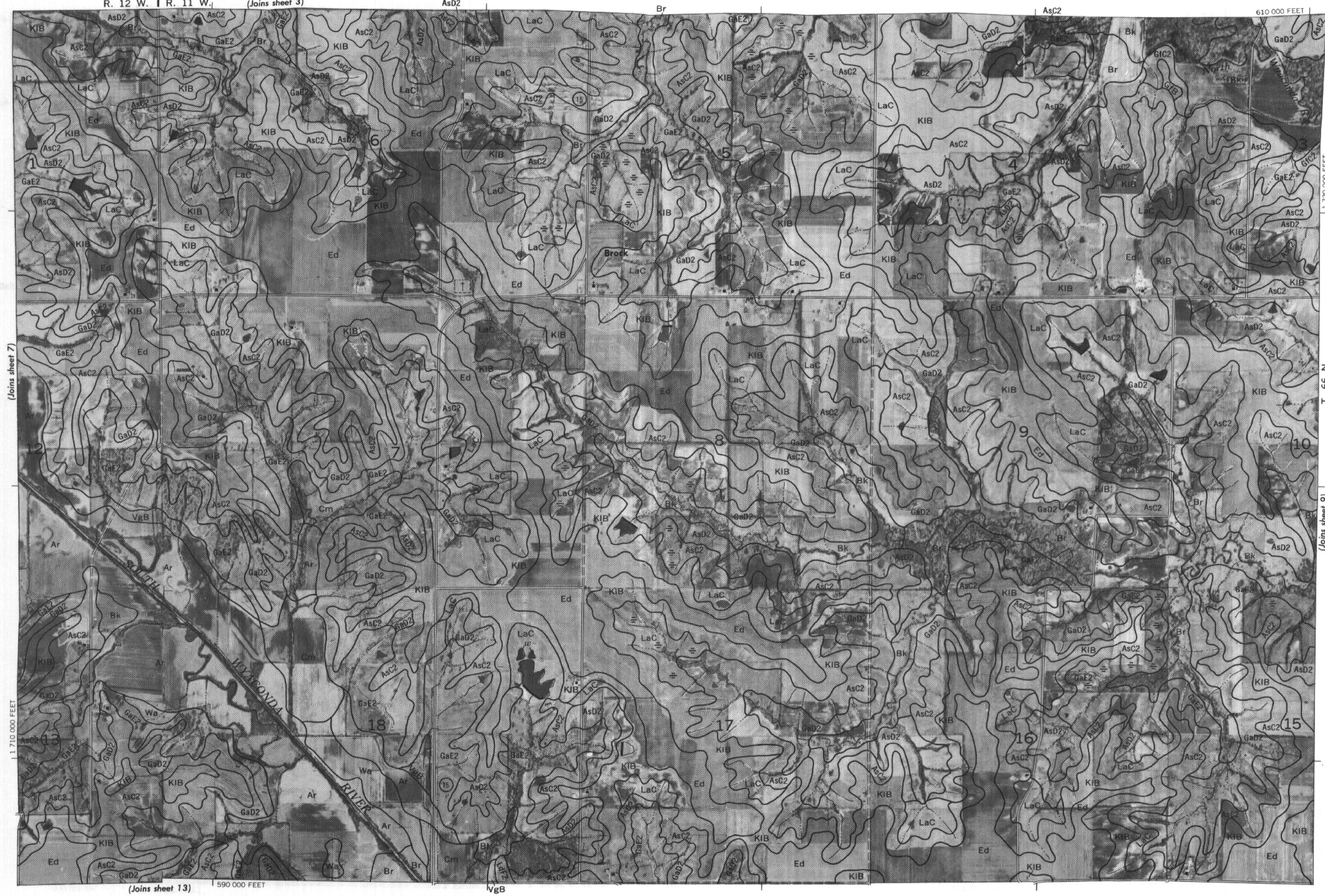
8



5000 Feet

Scale 1:20000

0 1000 2000 3000 4000 5000



(Joins sheet 9)

1 720 000 FEET

610 000 FEET

SCOTLAND COUNTY, MISSOURI NO. 8

Photobase from 1972 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, central zone. This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.

R. 11 W. | R. 10 W.

○



(Joins sheet 14) | 630 000 FEET

SCOTLAND COUNTY, MISSOURI — SHEET NUMBER 10

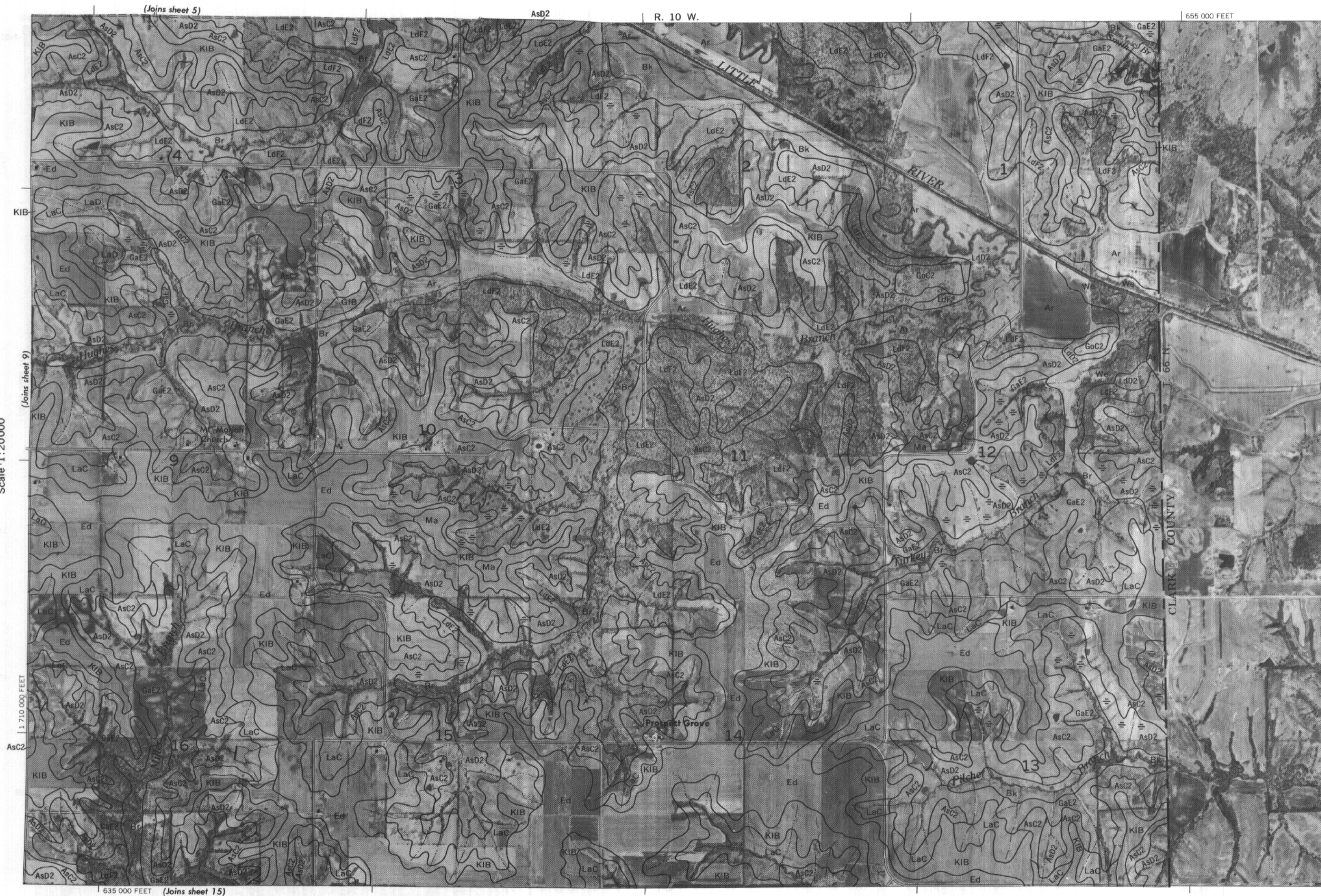
10



1 Mile
5000 Feet

Scale 1:20000

0 1000 2000 3000 4000 5000
1 1/4 1/2 1/4 1/8



SCOTLAND COUNTY, MISSOURI NO. 10

Photobase from 1972 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, central zone. This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.



(Joins sheet 16) | 560 000 FEET

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Land division corners are approximately positioned on this map.

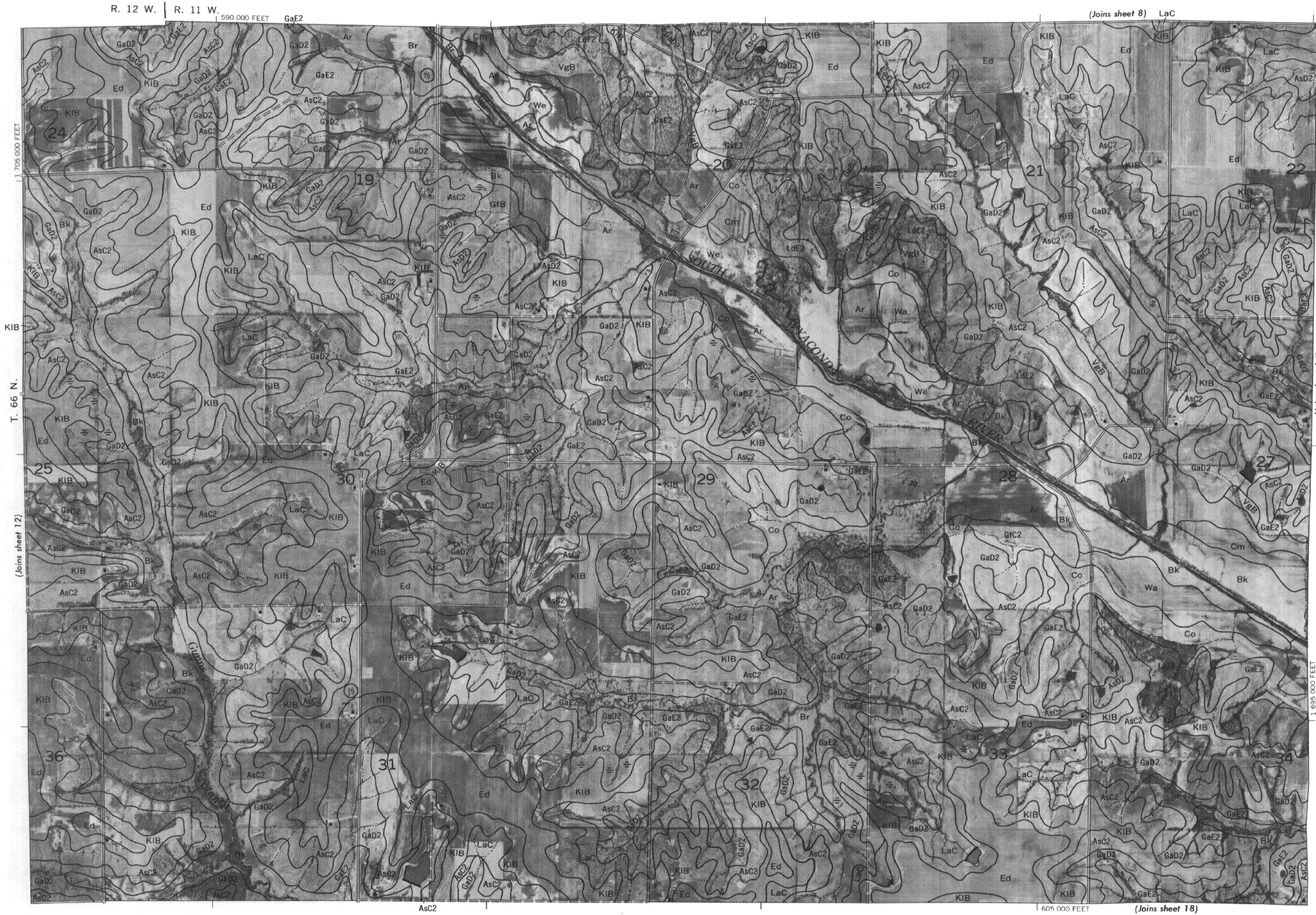
Photobase from 1972 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, central zone.

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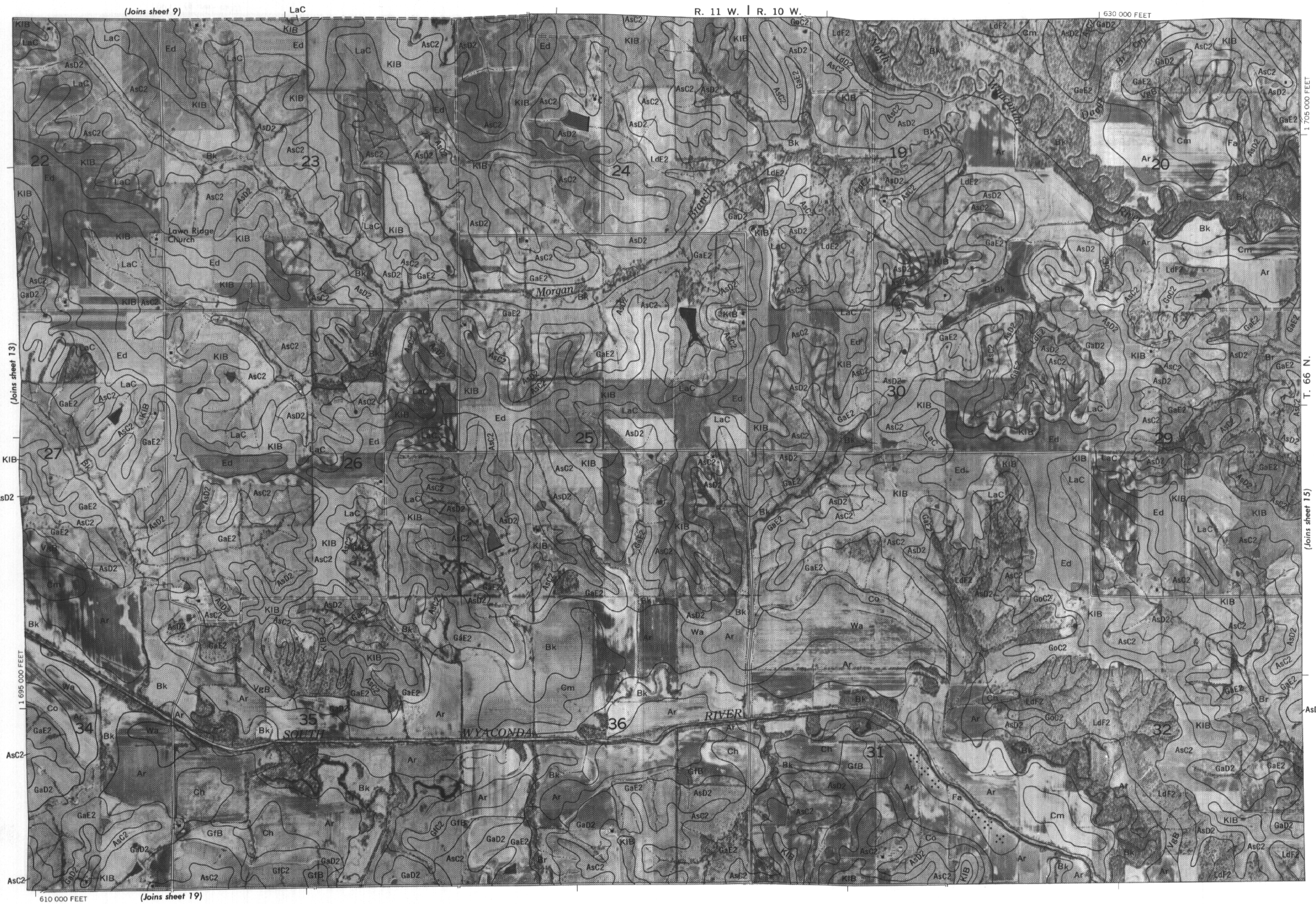
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SCOTLAND COUNTY, MISSOURI NO. 13



SCOTLAND COUNTY, MISSOURI — SHEET NUMBER 14

14



SCOTLAND COUNTY, MISSOURI NO. 14

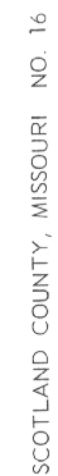
Land division corners are approximately positioned on this map.
Photobase from 1972 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, central zone.
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SCOTLAND COUNTY, MISSOURI NO. 15

(Joins sheet 20)

655 000 FEET



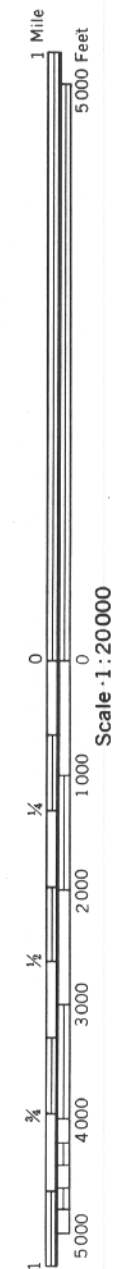
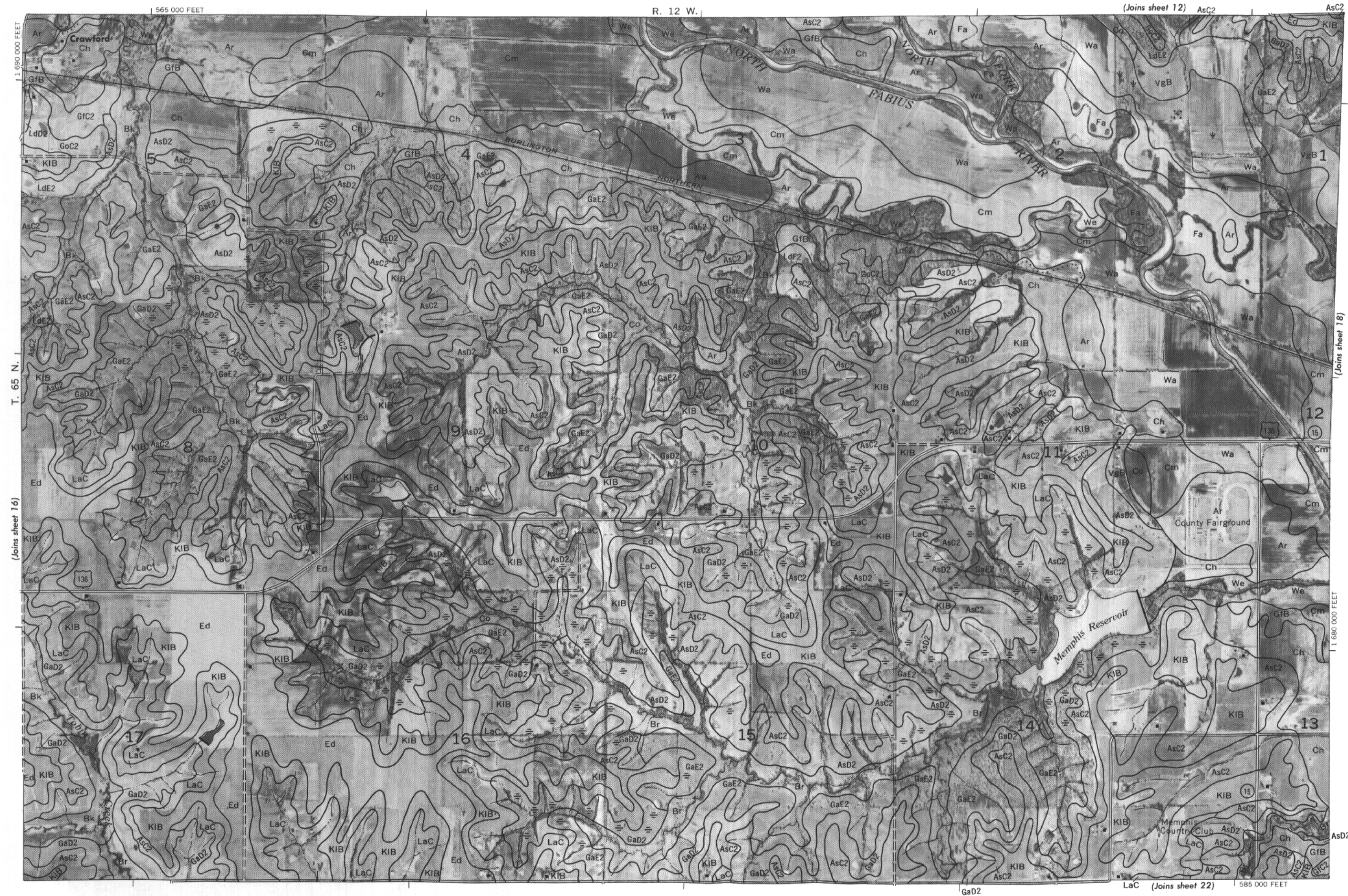
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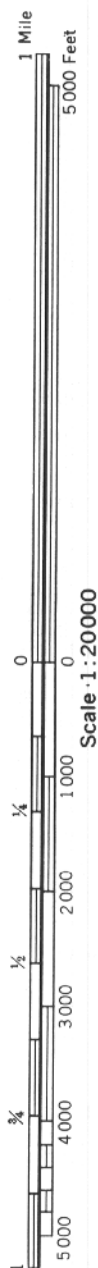
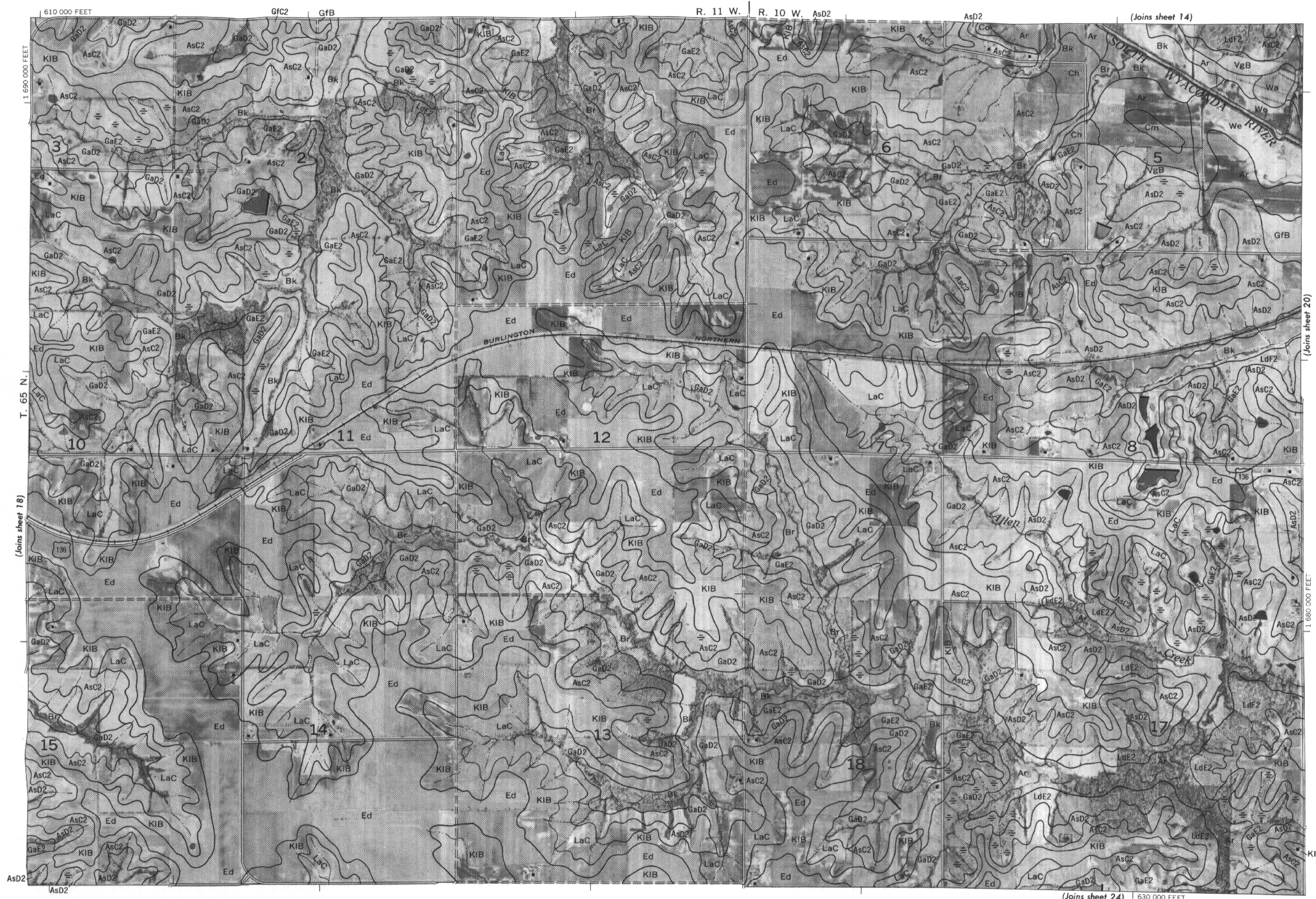
SCOTLAND COUNTY, MISSOURI NO. 17

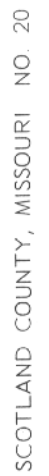


SCOTLAND COUNTY, MISSOURI — SHEET NUMBER 19

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SCOTLAND COUNTY, MISSOURI NO. 19

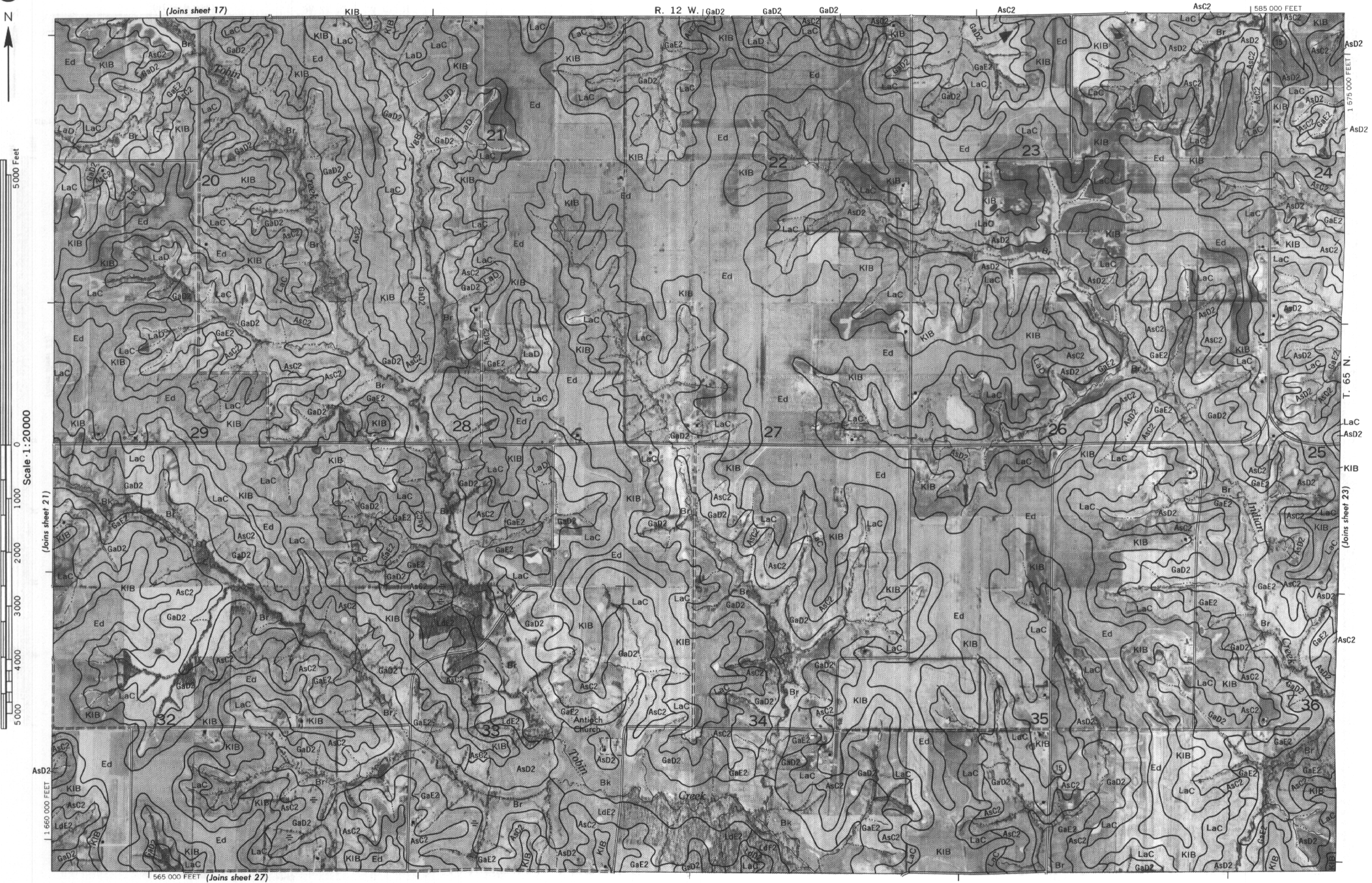




Land division corners are approximately positioned on this map.

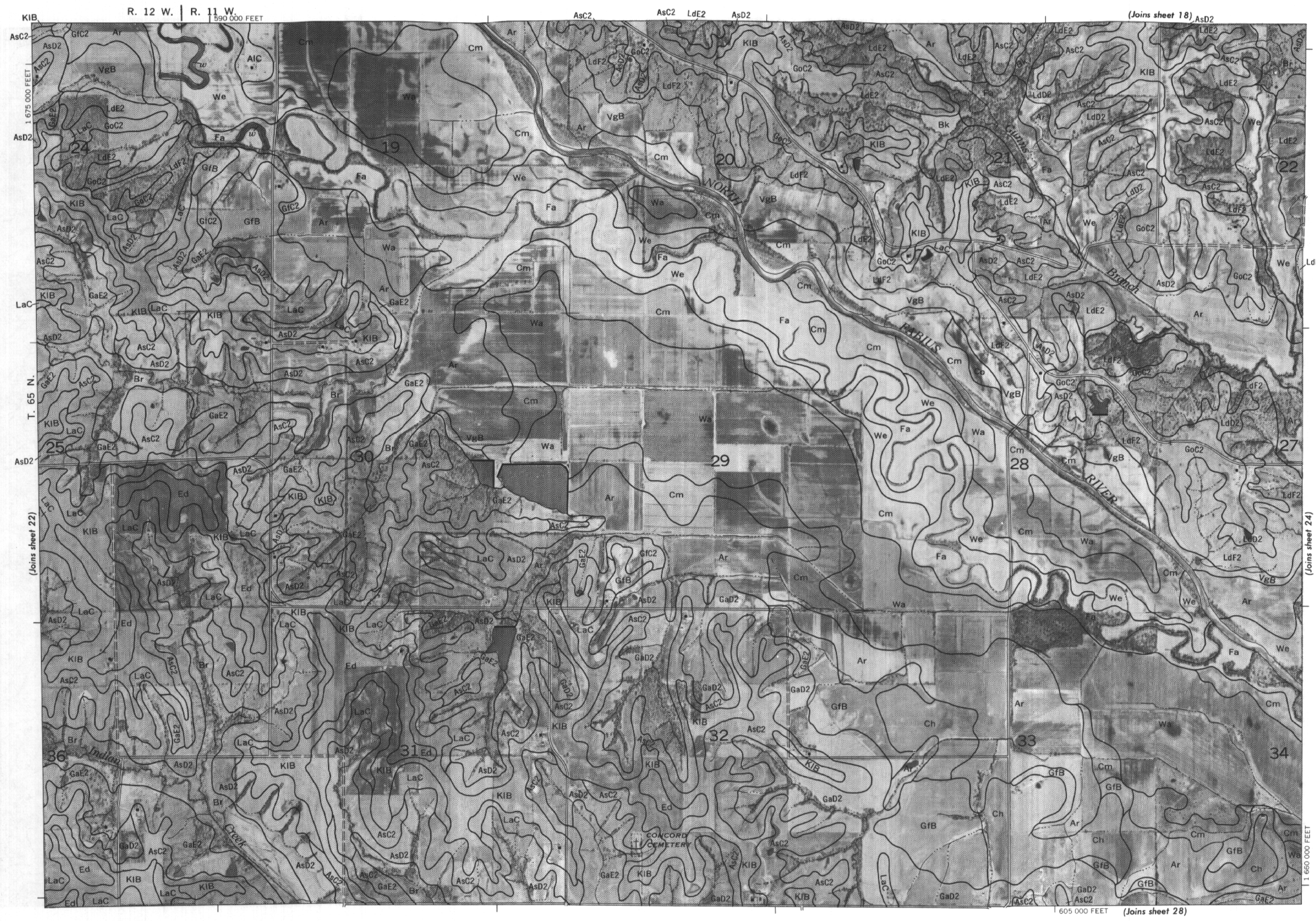
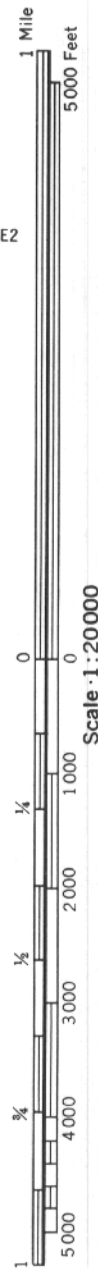
Photobase from 1972 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, central zone.

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SCOTLAND COUNTY, MISSOURI — SHEET NUMBER 23

23



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SCOTLAND COUNTY, MISSOURI NO. 23

SCOTLAND COUNTY, MISSOURI — SHEET NUMBER 24

24



5 000 Feet

Scale 1:20000



5 000 Feet

(Joins sheet 19)

R. 11 W. | R. 10 W.

1 630 000 FEET

1 675 000 FEET

T. 65 N.

(Joins sheet 25)

(Joins sheet 29)

GaE2



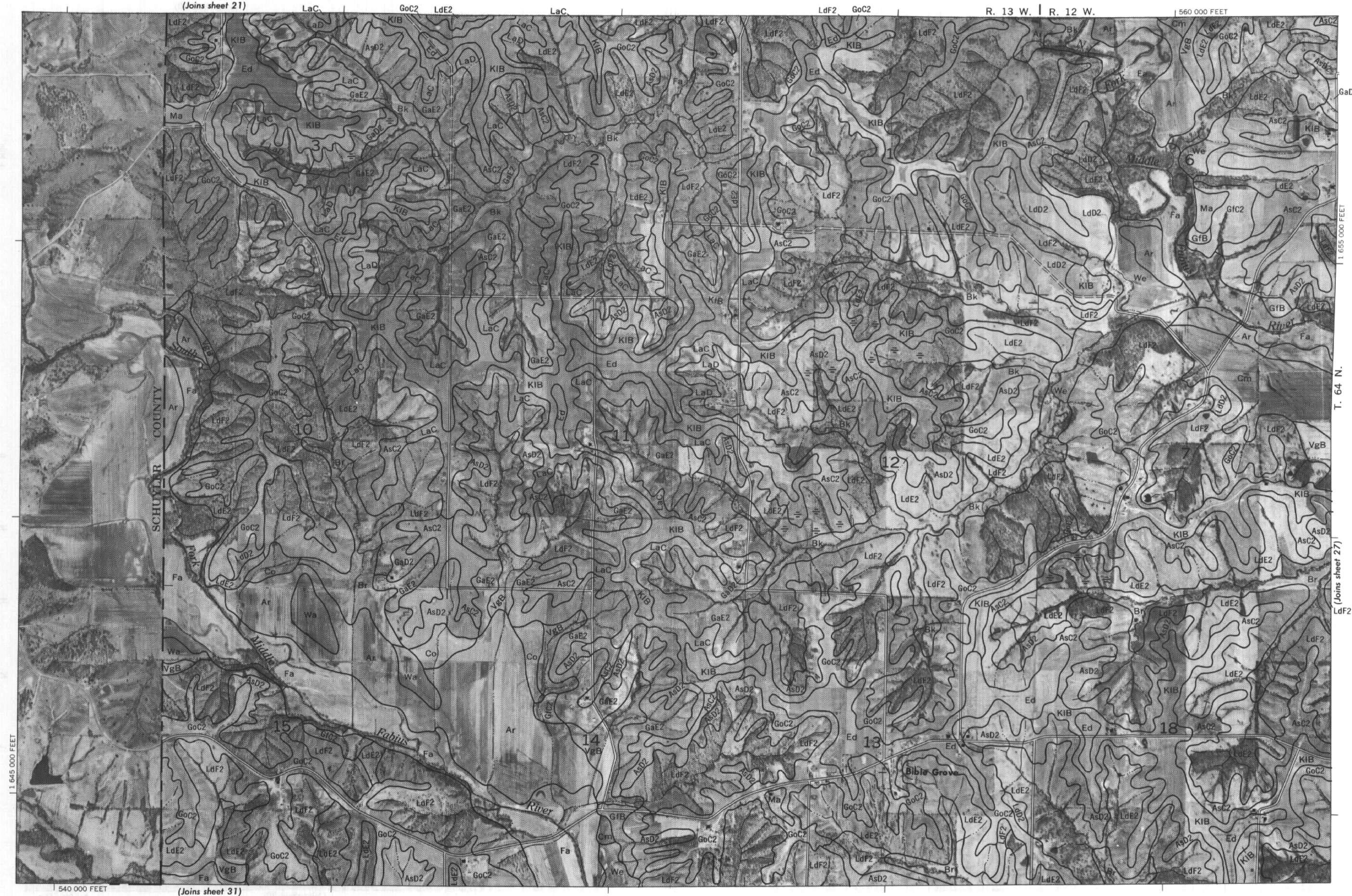
SCOTLAND COUNTY, MISSOURI NO. 24

Land division corners are approximately positioned on this map.
Photobase from 1972 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, central zone.
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SCOTLAND COUNTY, MISSOURI NO. 25





SCOTLAND COUNTY, MISSOURI NO. 27



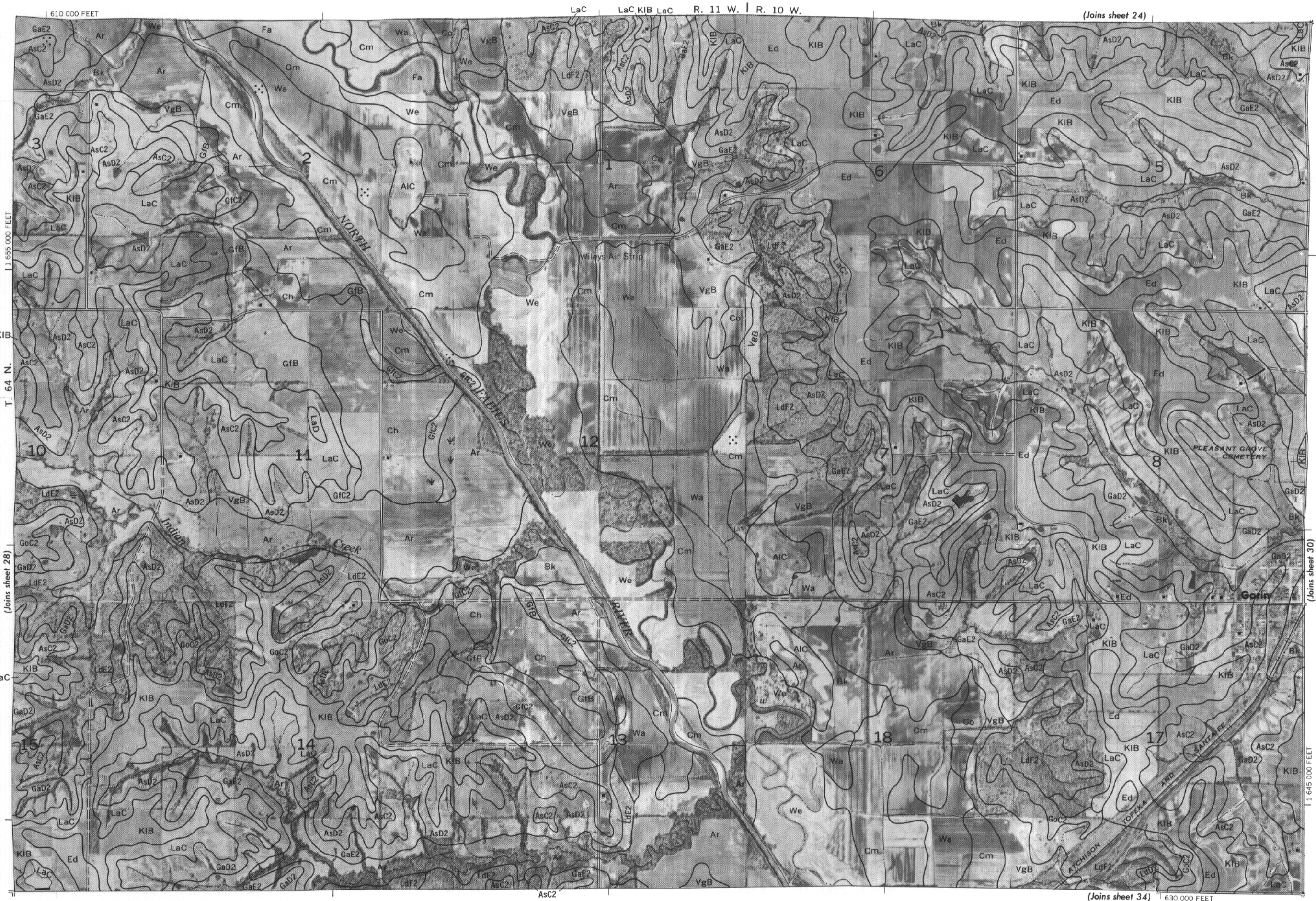
Land division corners are approximately positioned on this map.

Photobase from 1972 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, central zone.

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SCOTLAND COUNTY, MISSOURI — SHEET NUMBER 29

29



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SCOTLAND COUNTY, MISSOURI NO. 29

(Joins sheet 34) 630 000 FEET



SCOTLAND COUNTY, MISSOURI NO. 31

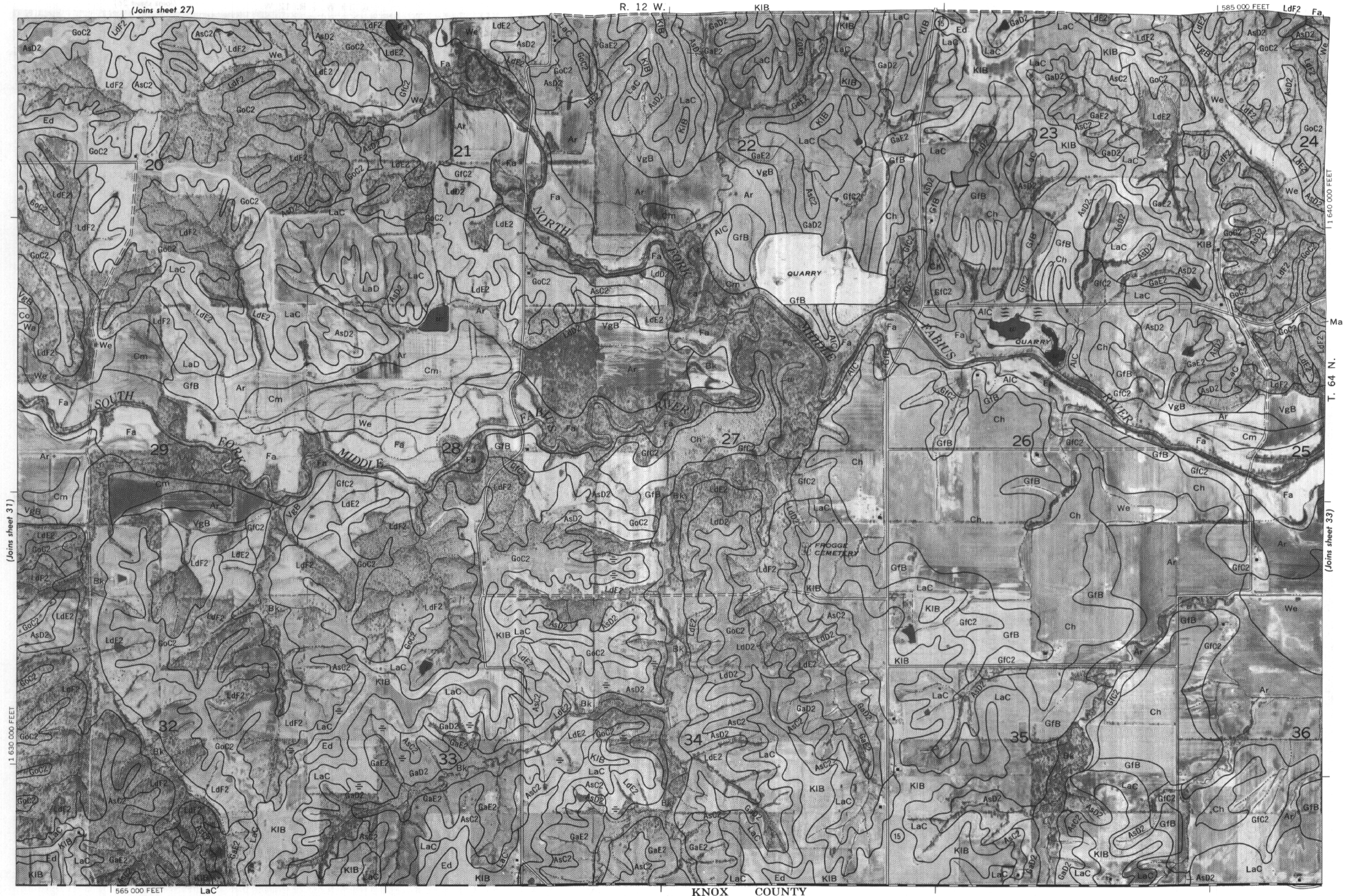
SCOTLAND COUNTY, MISSOURI — SHEET NUMBER 32

32



1 Mile
5000 Feet

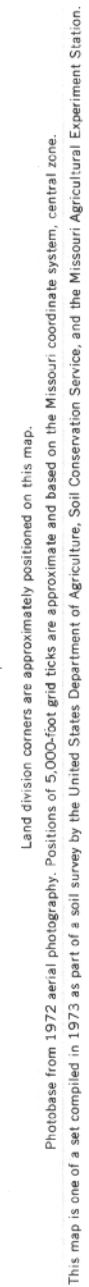
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SCOTLAND COUNTY, MISSOURI NO. 32

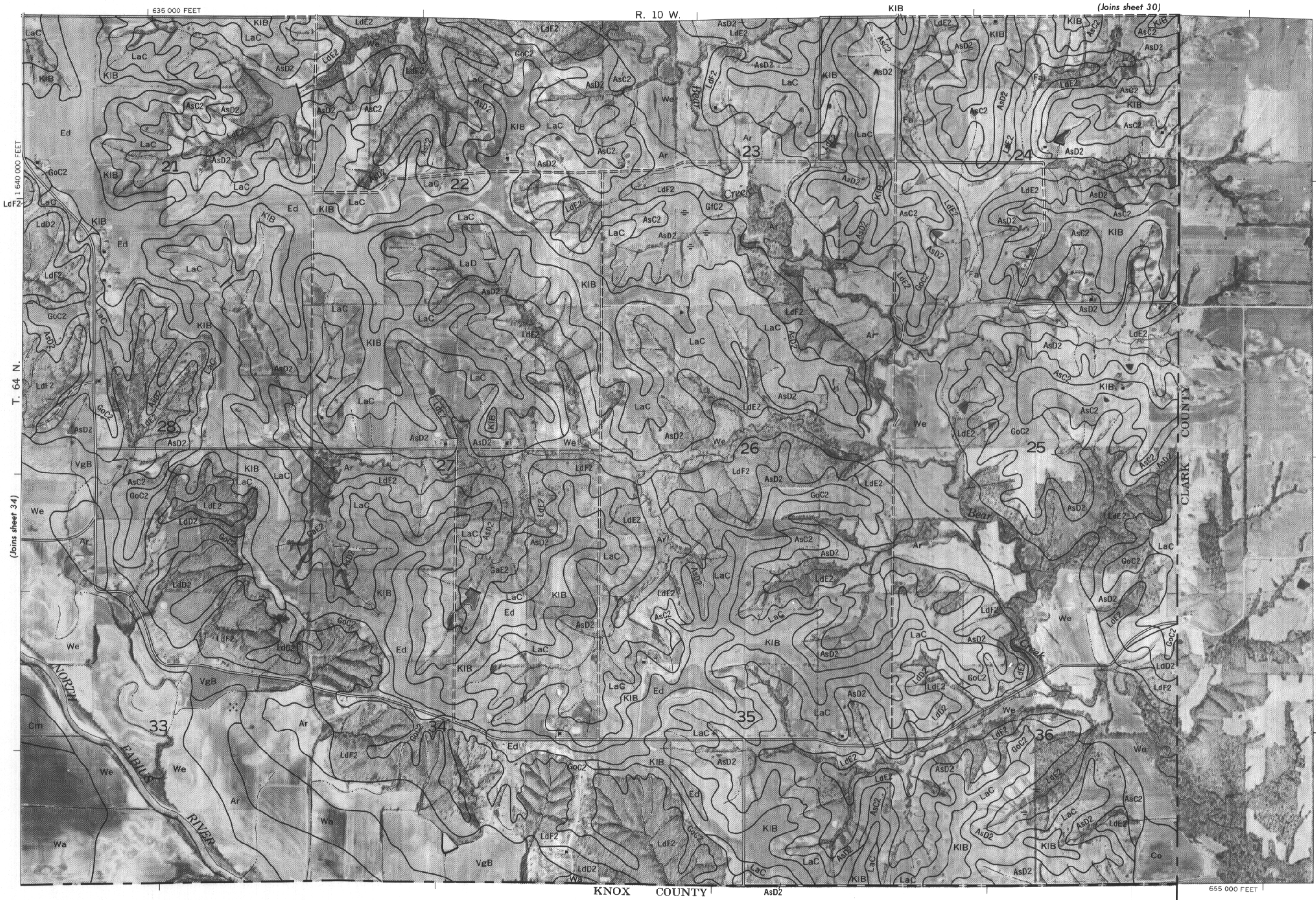
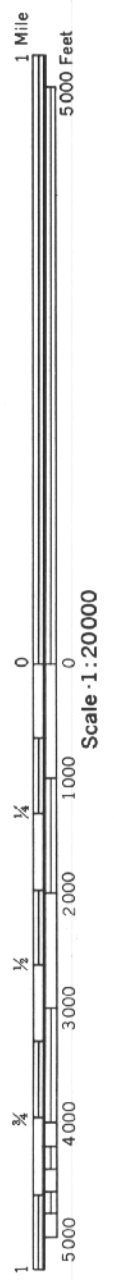
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SCOTLAND COUNTY, MISSOURI NO. 33



SCOTLAND COUNTY, MISSOURI — SHEET NUMBER 35

35



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SCOTLAND COUNTY, MISSOURI NO. 35